FAO Fisheries Circular No. 974

FIIT/C974

ISSN 0429-9329

# TROPICAL SHRIMP FISHERIES AND THEIR IMPACT ON LIVING RESOURCES

Food and Agriculture Organization of the United Nations

Copies of FAO publications can be requested from:
Sales and Marketing Group
Information Division
FAO
Viale delle Terme di Caracalla
00100 Rome, Italy
E-mail: publications-sales@fao.org
Fax: +39 06 570 53360

NMFS Honolulu Library
00000000000653

LIBRARY
NOAA, NMFS Honolulu Lab.
2570 Dole St.
Honolulu, Hawaii 96822-2396

# TROPICAL SHRIMP FISHERIES AND THEIR IMPACT ON LIVING RESOURCES

## Shrimp fisheries in Asia: Bangladesh, Indonesia and the Philippines; in the Near East: Bahrain and Iran; in Africa: Cameroon, Nigeria and the United Republic of Tanzania; in Latin America: Colombia, Costa Rica, Cuba, Trinidad and Tobago, and Venezuela

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2001

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to the Chief, Publishing and Multimedia Service, Information Division, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy or by e-mail to copyright@fao.org

© FAO 2001

## PREPARATION OF THIS DOCUMENT

In December 1998 the FAO Fisheries Department started the execution of a Project Development and Preparation Facility (PDF) funded by the Global Environment Facility (GEF) of the United Nations Environment Programme (UNEP): "Reducing the impact of tropical shrimp trawling fisheries on living marine resources through the adoption of environmentally friendly techniques and practices". In the process leading up to the project approval, thirteen countries with important shrimp fisheries in tropical regions decided to participate: in Asia: Bangladesh, Indonesia and the Philippines; in the Near East: Bahrain and Iran; in Africa: Cameroon, Nigeria and the United Republic of Tanzania; in Latin America: Colombia, Costa Rica, Cuba, Trinidad and Tobago, and Venezuela.

A workshop of National Coordinators of the participating countries, held at FAO Headquarters in March 1999, agreed on a common approach to development of a full project and later, in 1999/2000, four regional workshops (in Africa, Latin America, the Near East and Asia) were held to agree on regional priorities and content of a possible main phase project.

As background for the discussions, the participating countries agreed to carry out detailed reviews of their shrimp fisheries and basic studies on the environmental impact of these activities. These findings were summarized in national reports.

**Distribution:**
National Coordinators
Workshop participants
Fisheries Officers in FAO Regional and Subregional Offices
GEF Focal points in participating countries
Directors of Fisheries

FAO.
Tropical shrimp fisheries and their impact on living resources. Shrimp fisheries in Asia: Bangladesh, Indonesia and the Philippines; in the Near East: Bahrain and Iran; in Africa: Cameroon, Nigeria and the United Republic of Tanzania; in Latin America: Colombia, Costa Rica, Cuba, Trinidad and Tobago, and Venezuela
*FAO Fisheries Circular.* No. 974. Rome, FAO. 2001. 378p.

## ABSTRACT

As part of the development of the project "Reducing the impact of tropical shrimp trawling fisheries on living marine resources through the adoption of environmentally friendly techniques and practices", mainly funded by the Global Environment Facility (GEF), thirteen countries in tropical regions carried out a detailed review of their shrimp fisheries and studies on the environmental impact of these activities. The findings were summarized in national reports.

The national reports include: general description of the shrimp fishery (resources, fishing methods and vessel, fishing practice, effort data, shrimp catches and by-catches (including species and size composition and its utilization); regulations and management measures; research activities; impact of present exploitation and fishing practices on the shrimp and fish resources and on the bottom habitat; perception of the present situation by industry, the authorities and environmental organizations; social implications of adjusting fishing to more environmentally friendly practices; priority issues requiring actions to meet acceptable standards of environmentally friendly shrimp exploitation and, finally, a proposal for a relevant National Plan of Action.

In general, the national reports show that capture and discard of juvenile food fish and high discard levels of most of the non-shrimp catch are very serious problems for the countries. Many countries report existing regulations to reduce bycatch (including in some countries the mandatory use of the Turtle Excluder Device) and discarding, as well as management measures, like mesh size regulations and seasonal closure. A few countries also report the collecting, processing and marketing of bycatch. Conflicts about the use of fishing grounds and resources between industrial and artisanal fishers are commonly reported. The impact of trawling on the bottom habitat is an area where little knowledge exists, in general. A few countries also report, for the first time on observations made during systematic opinion poll survey.

CONTENTS

Page

## ASIA

**Bangladesh** 1

**THE IMPACT OF SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES OF BANGLADESH,** by Md. Masudur Rahman

**Indonesia** 40

**REDUCING THE IMPACT OF TROPICAL SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES THROUGH THE ADOPTION OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES IN THE ARAFURA SEA, INDONESIA,** by the National Committee for Reducing the Impact of Tropical Shrimp Trawling Fisheries in the Arafura Sea

**The Philippines** 71

**SHRIMP TRAWL FISHERIES IN THE PHILIPPINES,** by Jonathan O. Dickson

## NEAR EAST

**Bahrain** 96

**BAHRAIN SHRIMP FISHERY AND THE MARINE ENVIRONMENT**, by Ebrahim A. A. Abdulqader

**Iran** 138

**NATIONAL REPORT ON ENVIRONMENTAL IMPACT OF SHRIMP TRAWLING FISHERIES IN THE ISLAMIC REPUBLIC OF IRAN,** by Ali Asghar Mojahedi

## AFRICA

**Cameroon** 148

**NATIONAL REPORT ON REDUCING THE IMPACT OF TROPICAL SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES THROUGH THE ADOPTION OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES IN CAMEROON,** by J.C. Njock

**Nigeria** 188

**REDUCING THE IMPACT OF TROPICAL SHRIMP TRAWLING FISHERIES ON THE LIVING MARINE RESOURCES THROUGH THE ADOPTION OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES IN NIGERIA,** by Mr. J.C. Ogbonna

**United Republic of Tanzania** 216

**REDUCING THE IMPACT OF TROPICAL SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES THROUGH THE ADOPTION OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES IN TANZANIA,** by W. V. Haule

Page

## LATIN AMERICA

**Colombia** 234

**ANÁLISIS BIOLÓGICO PESQUERO Y ECONÓMICO DE LA FAUNA ACOMPAÑANTE EN LA PESQUERÍA DE ARRASTRE INDUSTRIAL COLOMBIANA. CONTRIBUCIÓN BIOLÓGICA Y ECONÓMICA PARA LA INVESTIGACIÓN Y EL DESARROLLO EN RECURSOS PESQUEROS COLOMBIANOS Y ESTIMACIÓN DEL IMPACTO DE LA FAUNA INCIDENTAL EN LA PESCA DE ARRASTRE DEL CAMARÓN**, por Carlos G. Barreto Reyes; Gustavo A. Polo Romero y Beatriz Mancilla Páramo

**Costa Rica** 271

**LA PESCA DE ARRASTRE DEL CAMARÓN EN COSTA RICA Y EL IMPACTO SOBRE EL AMBIENTE MARINO. LAS PESCAS DE CAMARONES EN COSTA RICA**, por Ricardo Gutierrez; **POSICIÓN DEL SECTOR CAMARONERO ARRASTRERO CON RELACIÓN A LOS ASPECTOS AMBIENTALES,** por Berny Enrique Marín Alpkar; **EVALUACIÓN DE LA PERCEPCIÓN DE LOS CAMBIOS TECNOLÓGICOS Y LA ACTITUD PARA MODIFICAR LAS PRÁCTICAS PESQUERAS,** por M.B.A. Angel Fco. Herrera Ulioa

**Cuba** 295

**REPORTE NACIONAL SOBRE EL IMPACTO DE LA FAUNA INCIDENTAL EN LA PESCA DE ARRASTRE DEL CAMARON**, por Lic. Luis Font Chávez

**Trinidad and Tobago** 308

**IMPACT OF SHRIMP FISHERIES IN TRINIDAD AND TOBAGO**, by Ms. Sita Kuruvilla

**Venezuela** 330

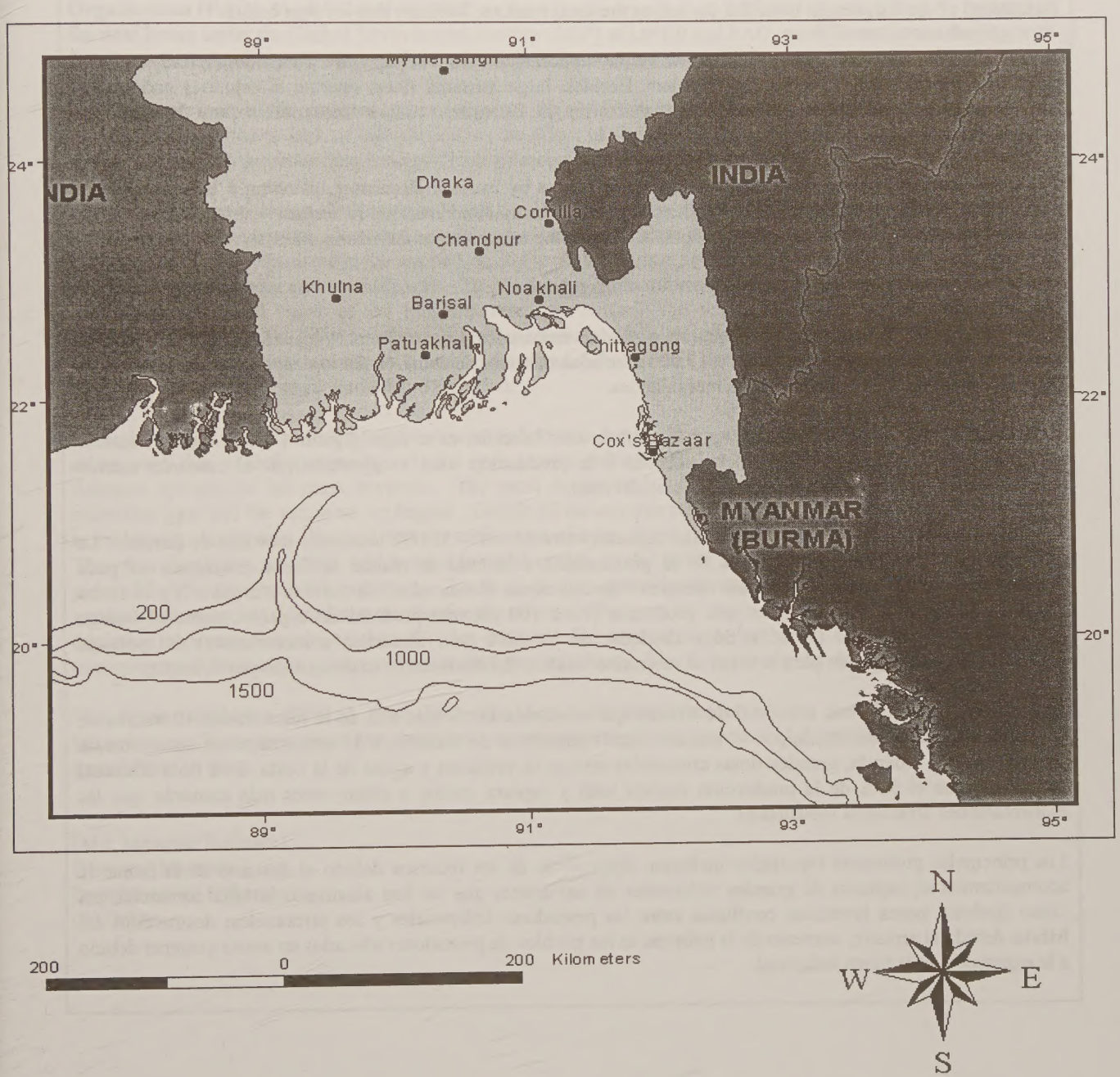
**REVISIÓN DE LA PESCA DE ARRASTRE EN VENEZUELA,** por Luis A. Marcano y José J. Alió, Daniel Novoa R., Douglas Altuve, Glennys Andrade y Rodolfo Álvarez

# ASIA

## BANGLADESH

### THE IMPACT OF SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES OF BANGLADESH

by Md. Masudur Rahman (Director (Marine) of the Department of Fisheries, Matshya Bhaban, Ramna, Dhaka-1000; Bangladesh; PABX: 9566103-4/02)



## Abstract

The shrimp catch by trawlers was 3 700 t for 1998/99. In addition, about 16 000-17 000 t of shrimp are caught by artisanal gear from mechanized boats.

Giant tiger (*Penaeus monodon*) is the most valuable and hence the targeted species. But the highest contribution to the total production is from brown shrimp (*Metapenaeus* spp.) (almost two thirds of the total).

It is estimated that the shrimp trawlers catch 45 000-52 000 t of fish. The species composition depends on the water depth. In the shallower waters (40 to 70 m) the croaker and grunter species are mainly found whereas breams and scads are predominant in the deeper waters (70-100 m). Only about 20% (with a tendency to increasing) of the fish caught is landed for sale at the local markets, 80% are thrown over board.

In 1998/99, the industrial trawling fleet which is supposed to work beyond the 40 m depth line, included 44 shrimp trawlers and 15 white fish trawlers. Besides, large artisanal fleets operate in estuaries and coastal waters and contribute 95% of the total marine production, including four to five times more shrimp than from the industrial trawlers.

The main problems reported include: wastage of resources by bycatch discarding, catching a large number of shrimp broods (fry) and juvenile fish, conflicts between industrial and artisanal fishermen, habitat destruction by trawling, increasing poverty of coastal fisherfolk through the expansion of the fishing industry.



## Resumen

Entre 1998 y 1999, la captura de camarón mediante embarcaciones arrastreras alcanzó las 3.700 toneladas métricas. Adicionalmente, unas 16.000-17.000 toneladas métricas de camarón fueron capturadas mediante artes de pesca artesanales en embarcaciones mecanizadas.

La especie de mayor valor comercial, por lo tanto la más buscada, es el tigre gigante ("Giant tiger"; *Penaeus monodon*). Sin embargo, la mayor contribución a la producción total es aportada por el camarón marrón (*Metapenaeus* spp.) que alcanza casi dos tercios del total.

Se estima que las embarcaciones arrastreras capturan entre 45.000 - 52.000 toneladas métricas de pescado. La composición de las especies depende de la profundidad a la cual se realiza la faena. En aguas de poca profundidad (40 a 70 metros) son más comunes especies como el roncador / la corvina ("croaker") y el ronco ("grunter"), mientras que en aguas más profundas (70 a 100 metros) predominan especies como el besugo ("bream") y el chicharro ("scad"). Sólo alrededor de un 20% (con tendencia a incrementar) del pescado capturado es desembarcado para la venta en mercados locales, el 80% restante es descartado por la borda.

Entre 1998 y 1999, la flota industrial de arrastre que se supone faena más allá de la línea de los 40 metros de profundidad, estaba constituida por 44 embarcaciones arrastreras de camarón y 15 embarcaciones arrastreras de pescado blanco. Además, grandes flotas artesanales operan en estuarios y aguas de la costa. Esta flota artesanal contribuye con el 95% de la producción marina total y captura cuatro o cinco veces más camarón que las embarcaciones arrastreras industriales.

Los principales problemas reportados incluyen: desperdicio de los recursos debido al descarte de la fauna de acompañamiento; capturas de grandes volúmenes de camarones que no han alcanzado la talla comercial, así como también, peces juveniles; conflictos entre los pescadores industriales y los artesanales; destrucción del hábitat debido al arrastre; aumento de la pobreza de los pueblos de pescadores ubicados en zonas costeras debido a la expansión de la pesca industrial.

## PREFACE

A workshop was held in Rome, Italy from 17 to 19 March 1999 for the National Coordinators of different countries of the world on the impact of shrimp trawling fisheries on living marine resources. Designated National Coordinators attended the workshop from 14 countries. The undersigned presented a country paper for Bangladesh entitled Effects of Shrimp Trawling on Living Marine Aquatic Resources". Detailed discussions were held on the relevant subject and an exchange of views and information among the country delegates took place. On the basis of the results from discussions a guideline was presented for preparation of a *National Report* for each country. The National Coordinators were assigned the responsibility of preparing the national report based on information available on shrimp trawling in their countries. The report when complete was sent to FAO HQ, Rome, Italy at the specified time. The workshop was organized by the **Global Environment Facility (GEF) of the United Nations Environment Programme (UNEP) and the Food and Agriculture Organization (FAO).** A global project based on the national reports from different countries may be initiated in the near future under the Global Environment Facility (GEF) of UNEP and FAO, on different issues dealing with the conservation and management of the marine fisheries resources.

During preparation of the national report following the guideline provided at the workshop, a serious problem was encountered due to lack of information on the effect of shrimp trawling on living marine resources in our marine waters. No previous data were available in proper form on the issue.

Understanding the situation all the available reports, literature, cruise reports of the departmental research vessel, available commercial trawl data, etc., were examined and analyzed. Some basic information such as the presence of benthic organisms in the sea bottom and probable damaging effects on them due to trawling were not collected systematically and scientifically. To put the available information into order, the commercial trawler owners, skippers and crews of the trawlers were interviewed. The scientific officers, other marine fishery officers including all the crew members of the departmental research vessel, were also interviewed. Details of the nature and operation techniques of the shrimp and fish trawlers, mechanized and non-mechanized boats including the gear used were studied and recorded.

From the studies it was revealed that the marine fisheries living resources in Bangladesh are seriously affected in many ways due to shrimp trawling. There is also some fishing effort in the marine and estuarine area which damages the marine bio-mass severely. The most detrimental fishing gear among these is the shrimp fry collection gear and the estuarine set bagnet. Details of the adverse effects of these fisheries are also focused on in the report. So far it is observed that the catch rates of most of the species from marine sources are declining. The other damaging activities, which have harmful effects on the living resources, include water pollution like industrial discharge and oil pollution. Lack of proper surveillance and management due to institutional weakness are also considered responsible for the adverse effects on the marine fisheries resources. Due to stock depletion and reduction in catches for the artisanal fisheries multiple problems have emerged, including unemployment for a major group of the coastal fisheries communities living along the coast.

The Marine Fisheries Officers from both the Marine Fisheries Resource Unit and the Marine Fisheries Department, Chittagong, extended their help in preparation of the report and I would like to express my gratefulness to them.

(Md. Masudur Rahman)
Director (Marine)
Department of Fisheries
(23.9.99)

## 1. INTRODUCTION

Bangladesh is situated at the northern end of the Bay of Bengal between latitude 20°34' and 26 °38' north and 88°01' and 92 °41' east. The country is endowed with vast inland water resources in the form of rivers, flood-plains, ponds, etc., and marine water, the Bay of Bengal, having great fisheries potential. The inland water of Bangladesh is over 4 million hectares. The country has a 710 km long coastline and approximately 1 million hectares of territorial waters extending up to 19 km. The nation's economic zone extends 320 km (200 nm) out to the sea from the baseline. The total marine water area of Bangladesh is about 164 000 km$^2$ of which more than 24 000 km$^2$ is shallower than 10 m. The marine waters of the Bay of Bengal are nutrient rich providing a suitable habitat for fish production. Marine fisheries consist of the industrial fishery using large trawlers and the artisanal fishery using mechanized and non-mechanized boats. The contribution of fisheries to the national economy of Bangladesh is substantial, particularly with reference to food consumption, nutrition, employment and export. The sector contributes 4.7% to the national GDP, 7% to the agricultural GDP and 10% to the export earnings. The average annual growth rate of the fisheries sector over the years is 4.6%. The fisheries sector provides full-time employment to 1.2 million professional fishermen and 11million part-time fisherfolk, the total of which is about 10% of the total population of the country.

The fisheries sector contributes about 78% of the animal protein intake in Bangladesh. However a continuous increase in fish production has not been able to cope with the fast-growing population. The country's fish production has increased from 640 000 metric tonnes (inland 545 000 metric tonnes, marine 95 000 metric tonnes) in 1975-76 to 1 373 000 metric tonnes (inland 1 079 000 metric tonnes, marine 294 000 metric tonnes) in 1996-97. But, at the same time, because of a fast increase in population the per capita fish consumption has declined from 33 to 20 g.

At present the marine fisheries sector contributes only about 22% of the country's total production, despite a sizeable marine and brackish water area within the EEZ. This sector has not been properly developed so far. Because of an unplanned and irrational increase in fishing effort many of the marine fish and shrimp stocks have already declined. As a result, coastal fishing has become non-remunerative and the fisherfolk are getting poorer, thus putting more and more damaging pressure on the resources.

## 2. DESCRIPTION OF THE MARINE AND COASTAL AREA

As already mentioned above Bangladesh has an Exclusive Economic Zone (EEZ) which extends to 200 nautical miles out to sea covering an area of 164 000 km$^2$. The territorial limit is 12 nautical miles out to sea from baseline (at 10 fathom depth counter). A large proportion of the shelf of Bangladesh is shallower than 10 m covering about 24 000 km$^2$ area. The whole shelf area of Bangladesh from 10 m depth to the shelf edge, i.e. up to 200 m depth contour, is about 43 440 km$^2$. The details of the marine water area are shown below:

**AREA OF THE CONTINENTAL SHELF OF BANGLADESH**

| Depth Zone (m) | Area (km$^2$) |
|---|---|
| 0 – 10 | 24 000 |
| 11 – 25 | 8 400 |
| 26 – 50 | 4 800 |
| 51 – 75 | 5 580 |
| 76 – 100 | 13 410 |
| 101– 200 | 10 250 |
| **Total Area** | **66 440** |

**TOTAL MARINE AREA**

| | |
|---|---|
| Coastline | 710 km |
| Internal water up to 10 fathoms (base line) from the coastline | 25 000 km$^2$ |
| Territorial water up to 12 nautical miles from the base line | 8 940 km$^2$ |
| EEZ (from the base line), this includes territorial water | 139 000 km$^2$ |
| Total sea water (EEZ + internal water) | 164 000 km$^2$ |

## WATER QUALITY PARAMETERS OF THE BAY OF BENGAL

Very little is known about the hydrological features of the water bodies of the Bay of Bengal in Bangladesh. The sea is changing and has a moving ecosystem with large varieties of bio-topics, regional geology, substrates, depths, currents and nutrients which differ from place to place. Generally, the inshore waters near the estuaries have very high turbidity due to heavy run-off from the major rivers. On the other hand the offshore waters are more transparent (The maximum Sechi Disc reading was 27 m).

The surface water temperature of the EEZ of the Bay of Bengal varies from 17° to 33°C and salinity from 18 to 37 ppt. The bottom water salinity ranges from 28 to 39 ppt. Waters of the continental shelf areas are relatively rich in plankton and contain high oxygen (4.8 ppm at the surface and 4.0 ppm at 35 depth), nitrates and minerals.

## 3. MARINE FISHERIES RESOURCES OF BANGLADESH

### 3.1 Exploited and un-exploited resources

**Major fish species exploited**

There are 475 species of fish and 36 species of marine shrimp in the marine waters. Among these, 90 species of fish are commercially important. The most common species of fish are as follows:

| | Scientific Name | Local Name |
|---|---|---|
| 1. | *Pampus argenteus* | Silver Pomfret |
| 2. | *Pampus chinensis* | Chinese Pomfret |
| 3. | *Pomadasys hasta* | White grunter |
| 4. | *Lutjanus johni* | Red snapper |
| 5. | *Mene maculata* | Moon fish |
| 6. | *Polynemus indicus* | Indian salmon |
| 7. | *Lepturacanthus savala* | Ribbon fish/har tail |
| 8. | *Arius spp.* | Cat fish |
| 9. | *Johnius belangerii* | Croaker |
| 10. | *Otolithoides argenteus* | Croaker |
| 11. | *Namipterus japonicus* | Japanese threadfin bream |
| 12. | *Upeneus sulphureus* | Goat fish |
| 13. | *Saurida tumbil* | Lizard fish |
| 14. | *Llisha filigera* | Big eye ilisha |
| 15. | *Sphyraena barracuda* | Great barracuda |
| 16. | *Muraenesox telabonoides* | Indian pike conger |

**Major shrimp species exploited**

The Bangladesh offshore commercial trawl fishery has been developed on the basis of the valuable exportable Penaeid shrimp resources. The commercial shrimp species are listed here:

| | Scientific Name | English Name |
|---|---|---|
| 1. | *Penaeus monodon* | Giant black tiger |
| 2. | *Penaeus semisulcatus* | Tiger |
| 3. | *Penaeus japonicus* | Tiger |
| 4. | *Penaeus indicus* | Indian white |
| 5. | *Penaeus merguiensis* | Banana/white |
| 6. | *Metapenaeus monoceros* | Brown |
| 7. | *Metapenaeus brevicornis* | Brown |
| 8. | *Metapenaeus spinulatus* | Brown |
| 9. | *Parapenaeopsis sculptilis* | Pink |
| 10. | *Parapenaeopsis stylifera* | Pink |

Among the shrimp exploited *Penaeus monodon* is the most valuable and hence is the targeted species. But the highest contribution in the total production, however, is made up by *Metapenaeus monoceros*, brown shrimp which is about 63%. The major penaeid shrimp and demersal fish are abundantly distributed within the 100 m depth. So far four fishing grounds are identified within the continental shelf (Fig. 1). Distribution of shrimp and fish including other fauna at different depth with their percentages are shown in Tables 1 and 2.

**Un-exploited and under-exploited species**

Other than the fish species mentioned earlier a number of other important species of fish are available in the marine waters of Bangladesh which are either unexploited or exploited only as by-catch or as incidental catch by the existing trawl or gillnet fisheries. It is worth mentioning in particular the species listed below:

**Tuna and Skipjack**

| | Scientific Name | English Name |
|---|---|---|
| 1. | *Euthynnus affinis* | Eastern little tuna |
| 2. | *Katsuwonus pelamis* | Skipjack tuna |
| 3. | *Thunnus maccoyii* | Southern bluefin tuna |
| 4. | *T. obesus* | Bigeye tuna |
| 5. | *T. tonggol* | Longtail tuna |
| 6. | *Auxis rochei* | Bullet tuna |
| 7. | *A. thazard* | Frigate tuna |

**Mackerels**

The drift gillnetters also catch mackerel as by-catch of the hilsa fishery. Four types of mackerel (e.g. king mackerel, Spanish mackerel, Indian mackerel and short bodied mackerel) were recorded. These species are also found to occur in the trawl catch accidentally:

| | Scientific Name | English Name |
|---|---|---|
| 1. | *Scomberomorus guttatus* | King mackerel |
| 2. | *S. commerson* | Spanish mackerel |
| 3. | *Rastrelliger kanagurta* | Indian Mackerel |
| 4. | *R. brachysoma* | Short bodied mackerel |

The others include 4 species of sardines, 3 species of anchovies, 13 species of carangids and 5 species of lobsters which are caught by gillnets, shrimp and bottom fish trawlers, as by-catch.

**Non-conventional resources**

Some cephalopods are also caught by the bottom fish and shrimp trawlers as by-catch. These are also found in some artisanal fishing gear at their younger stages. Three species of cephalopods (*Sepia offininalis,Loligo spp., Octopus sp.*) were recorded.

Sharks and rays are exploited by drift gillnets as well as by longlining. The main species recorded were *Sphyrna blochii, Stegostoma fasciatum, Chiloscyllium indicum, Scoliodon walbeehmii, S. sorrakowah, Carcharhinus menisorrah, Pristis cuspidatus, P. zijsron, Rhynchobatus djeddensis, Rhinobatos granulatus* and *Dasyatis uarnak.*

### 3.2 Standing stock

A number of surveys have been conducted since 1958 in the marine waters of Bangladesh. Most of these surveys were exploratory in nature and oriented to studies for fisheries feasibility. Some surveys were conducted to assess the standing stock of the marine resources, particularly the demersal part of it. However, hardly any survey work has been done for a reasonable assessment for the pelagic resources.

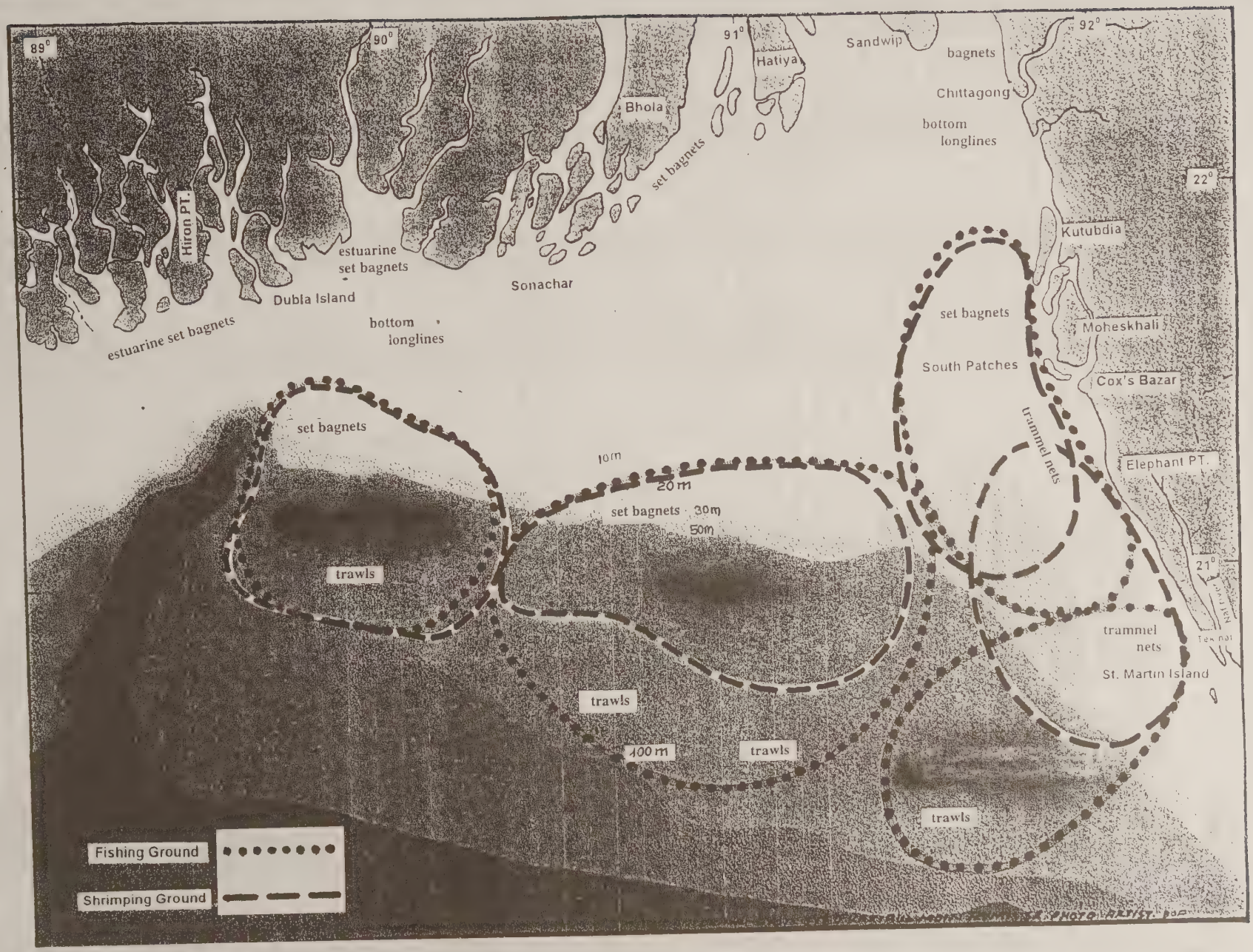



**Fig. 1 Fishing and Shrimping Grounds in the Continental shelf of Bangladesh**

TABLE 1. DISTRIBUTION OF SHRIMP AND FISH INCLUDING OTHER AQUATIC FAUNA WITH PERCENTAGE BY WEIGHT AT DIFFERENT DEPTHS OF THE BAY OF BENGAL

| Sl. No. | Family | English Name | Depth zone | | | Total (%) |
|---|---|---|---|---|---|---|
| | | | 20-50 m | 51-80 m | 81-100 m | |
| | | | % | % | % | |
| 1. | Nemipteridae | Threadfin bream | 2.07 | 34.23 | 55.54 | 19.73 |
| 2. | Mullidae | Goat fish | 13.08 | 2.93 | 1.93 | 7.74 |
| 3. | Sciaenidae | Jew fish | 9.73 | 4.74 | 7.71 | 7.25 |
| 4. | Penaeidae | Shrimp | 4.56 | 9.20 | 3.71 | 6.75 |
| 5. | Synodontidae | Lizard fish | 8.10 | 3.45 | 8.15 | 5.86 |
| 6. | Ariidae | Cat fish | 5.58 | 6.16 | 5.17 | 5.84 |
| 7. | | Trash fish | 7.34 | 4.27 | 1.38 | 5.62 |
| 8. | Leiognathidae | Pony fish | 10.20 | 1.06 | 0.00 | 5.39 |
| 9. | Apogonidae | Cardinal fish | 0.37 | 9.50 | 3.52 | 4.89 |
| 10. | Trichiuridae | Hairtail | 3.74 | 4.85 | 7.54 | 4.43 |
| 11. | Clupeidae | Herring,sardine,shad | 5.09 | 3.10 | 1.27 | 3.98 |
| 12. | Carangidae | Jackes,scad etc. | 3.96 | 4.27 | 0.00 | 3.94 |
| 13. | | Misxed fish | 4.77 | 0.61 | 0.00 | 2.57 |
| 14. | Gerreidae | Mojarras | 2.78 | 0.83 | 0.00 | 1.73 |
| 15. | Cephalopoda | Squid,cuttlefish etc. | 1.88 | 1.36 | 0.32 | 1.57 |
| 16. | | Rays | 2.94 | 0.04 | 0.00 | 1.43 |
| 17. | Pomadasydae | Grunters | 2.46 | 0.35 | 0.00 | 1.35 |
| 18. | Stromateidae | Pomfrets | 1.01 | 1.09 | 1.32 | 1.06 |
| 19. | Cynoglossidae | Tongue sole | 0.89 | 1.30 | 0.19 | 1.06 |
| 20. | Lactariidae | False trevallies | 1.78 | 0.24 | 0.45 | 0.98 |
| 21. | Sphyraenidae | Barracuda | 0.41 | 1.00 | 0.00 | 0.68 |
| 22. | Carcharhinidae | Sharks | 0.62 | 0.65 | 0.61 | 0.63 |
| 23. | Triacanthidae | Spike fish | 1.23 | 0.00 | 0.00 | 0.59 |
| 24. | Scombridae | Mackerels & Tunas | 0.82 | 0.41 | 0.00 | 0.59 |
| 25. | Ariomidae | Drift fish | 0.17 | 0.91 | 0.00 | 0.52 |
| 26. | Psettodidae | Halibut | 0.70 | 0.29 | 0.00 | 0.47 |
| 27. | Tetradontidae | Puffer fish | 0.73 | 0.11 | 0.22 | 0.40 |
| 28. | Triglidae | Gunnards | 0.05 | 0.79 | 0.00 | 0.40 |
| 29. | Muraenesocidae | Pike eel | 0.13 | 0.64 | 0.00 | 0.37 |
| 30. | Engraulidae | Anchovies | 0.23 | 0.46 | 0.22 | 0.34 |
| 31. | Theraponidae | Terapon perches | 0.43 | 0.00 | 0.02 | 0.21 |
| 32. | | Other crustaceans | 0.12 | 0.27 | 0.25 | 0.20 |
| 33. | Lutjanidae | Snapper | 0.32 | 0.08 | 0.00 | 0.19 |
| 34. | Drepenidae | Sicklefish | 0.37 | 0.00 | 0.00 | 0.18 |
| 35. | Priacanthidae | Bulls eye | 0.01 | 0.31 | 0.55 | 0.17 |
| 36. | Chirocentridae | Wolf herring | 0.23 | 0.10 | 0.03 | 0.16 |
| 37. | Platycephalidae | Flat head | 0.80 | 0.18 | 0.11 | 0.13 |
| 38. | Serranidae | Groupers | 0.23 | 0.05 | 0.00 | 0.13 |
| 39. | Ephippidae | Spade fish | 0.25 | 0.22 | 0.22 | 0.12 |
| 40. | Fistulariidae | Flute mouths | 0.13 | 0.10 | 0.00 | 0.11 |
| 41. | | Sharks & rays | 0.10 | 0.05 | 0.00 | 0.07 |
| 42. | Sparidae | Sea breams | 0.12 | 0.01 | 0.00 | 0.06 |
| 43. | Polynemidae | Threadfins | 0.07 | 0.01 | 0.02 | 0.04 |
| 44. | Rachycentridae | Cobias | 0.05 | 0.00 | 0.00 | 0.03 |
| 45. | Menidae | Moon fish | 0.03 | 0.00 | 0.00 | 0.01 |
| 46. | Balistadae | Tigger fish | 0.02 | 0.00 | 0.00 | 0.01 |
| 47. | Echinidae | Suckers | 0.02 | 0.00 | 0.00 | 0.01 |
| 48. | Mugilidae | Grey mullet | 0.01 | 0.00 | 0.00 | 0.00 |

**TABLE 2. DISTRIBUTION OF COMMERCIALLY IMPORTANT SPECIES OF FISHES AT DIFFERENT DEPTH CONTOURS OF THE BAY OF BENGAL**

| Depth range 10 m. to 30 m. | | Depth range 31 m. to 50 m. | |
|---|---|---|---|
| Scientific name | English name | Scientific name | English name |
| *1. J. argentatus* | 1. Silver Croaker | *1. Johnius spp.* | 1. Croaker |
| *2. Johnius spp.* | 2. Jew fish or Croaker | *2. Harpadon nehereux* | 2. Bombay duck |
| *3. Otolithus argenteus* | 3. Tiger-tooth Croaker | *3. Lepturacanthus savala* | 3. Ribbonfish |
| *4. Pomadasys maculatus* | 4. Cock Grunt | *4. Muraenesox spp.* | 4. Eel fish |
| *5. P. hasta* | 5. Silver Grunt | *5. Otolithus argenteus* | 5. Tiger Tooth Croaker |
| *6. Arius spp.* | 6. Cat fish | *6. S. commersonius (commersonnianus)* | 6. Talang Queen fish |
| *7. Harpadon nehereus* | 7. Bombay duck | *7. Saurida tumbil* | 7. Lizard fish |
| *8. Pampus chinensis* | 8. Chinese pomfret | *8. Upeneus sulphureus* | 8. Goat fish |
| *9.Lutjanus spp.* | 9. Snapper | | |
| *10. Parastromateus niger* | 10.Black pomfret | | |
| *11. Polinemus indicus* | 11. Indian Threadfin | | |
| Depth range 51 m. to 70 m. | | Depth range 71 m. to 90 m. | |
| Scientific name | English name | Scientific name | English name |
| *1.P. argenteus* | 1. Silver pomfret | *1. Nemipterus japonicus* | 1. Threadfin bream |
| *2. Megalaspis cordyla* | 2. Torpedo Scad | *2. Megalaspis cordyla* | 2. Torpedo Scad |
| *3. Otolithus argenteus* | 3. Tiger-tooth Croaker | *3. Lutjamus spp.* | 3. Snapper |
| *4.Pomadasys Maculatus* | 4. Cock Grunter | *4. Parastromateus niger* | 4. Black pomfret |
| *5. S. commerson* | 5. Spanish mackerel | *5. Muraenesox. spp.* | 5. Eel fish |
| *6. Spyraena spp.* | 6. Barracuda | *6. S. Commerson* | 6. Spanish mackerel |
| *7. Upeneus sulphureus* | 7. Goat fish | *7. Johnius spp.* | 7. Croaker |
| *8. Arius spp.* | 8. Cat fish | *8. Ariomma indica* | 8. Butter fish |
| Depth range 91 m. to 100 m. | | | |
| Scientific name | English name | | |
| *1. Nemipterus japonicus* | 1. Threadfin bream | | |
| *2. Megalaspis cordyla* | 2. Torpedo Scad | | |
| *3. Epinephelus spp.* | 3. Grouper | | |

The demersal fishery resource assessment results are found to vary (West, 1973). Through a desk study West estimated a standing stock of demersal fish of 264 000 to 374 000 metric tonnes and that of shrimp standing stock as 9 000 metric tonnes. His estimation was, however, criticized by many authors. The recent results, i.e. FRIDTJOF NANSEN and ANUSANDHANI surveys before and after 1984 bring out similar results. The standing stock of demersal fish was estimated within a range of 150 000-160 000 metric tonnes by these surveys. At the same time, the standing stock of shrimp was estimated between 2 000 and 4 000 metric tonnes by different authors (Penn, 1983 and White & Khan, 1985).

### 3.3 Maximum sustainable yield

The results of stock assessment studies have been used to find out the fisheries potential for different resources. At this stage it has been estimated that 40 000 to 55 000 metric tonnes of demersal finfish can be harvested annually from the offshore fishing grounds lying between 10 and 100 m depth zones. The maximum sustainable yield of shrimp has been estimated to be 7 000 to 8 000 metric tonnes annually which also includes resources of shallower water zones. (Khan, *et al*, 1989).

## 4. PRESENT EXPLOITATION PATTERNS

### 4.1 Industrial/Trawl Fishery

The commercial trawl fishery developed in Bangladesh from 1972. At the present there are 45 shrimp trawlers and 14 finfish trawlers in operation. The finfish trawlers also include six trawlers owned by the Bangladesh Fisheries Development Corporation (BFDC) a public sector body. The overall length of shrimp trawlers varies from 20.5 to 44.5 m and that of the finfish trawlers ranges from 28.0 to 30.5 m. The engine power varies from 350 to 1200 HP, but mostly falls within the range of 550-850 HP. The manpower employed in the fish and shrimp trawl fisheries consists in about 23 crew members on board commercial trawlers, 6-10 and 3-15 on board mechanized and non-mechanized boats respectively.

The finfish trawlers mostly carry out single trawling from the stern with high opening bottom trawl nets ith 60 mm mesh size at the codend. The shrimp trawlers use outriggers and operate two to four nets at a .ime. These trawlers used modern shrimp trawl nets with the codend having a mesh size of 45 mm. The headrope length of the shrimp trawl net ranges in the trawler fleetfrom 15 to 26 m. Almost all the vessels are equipped with modern navigation, communication and fish finding equipment. Though trawl fishing has been restricted to operate within the 40 m depth contour they are found operating even up to a depth of 10 m. The main shrimp and fish species exploited by the trawl nets are *Penaeus mondon, P. merguiensis, P. indicus, Metapenaeus monoceros, M. brevicornis*, hartail, promfret, goat fish, cat fish, croakers, bombay duck, lizard fish, etc.

Fish landings by the commercial trawler fleets are within the range of 8 000-12 000 metric tonnes which is only 20% of the actual catch while 80%, equivalent to 35-45 000 metric tonnes (White and Khan, 1985) are discarded as low value by-catch at sea.

### 4.2 Artisanal/Small Scale Fisheries

Artisanal fishing operations in the estuaries and coastal waters used to be carried out by traditional craft until the mid 1960s. Two organizations, namely, the Bangladesh Fisheries Development Corporation (BFDC) and the Bangladesh Jatio Matshyajibi Samabay Samity (BJMSS) started the process of mechanization of fishing boats by importing and introducing marine engines.

These fisheries include different types of fishing gear and craft. Some of the gear are operated by the mechanized/motorized boats and some boats with oars or sails, popularly known as row or sail boats. Some gear are operated without any boat. There are five different types of gillnet (i.e. drift gillnet, fixed gillnet, large mesh gillnet, bottom set gillnet and mullet gillnet), two types of set bagnet (estuarine set bagnet and marine set bagnet). Trammel net, bottom longlines, beach seine and many other nets which are scattered throughout the coast and estuaries. Area of operation of the main fishing gear in the coastal and marine waters of Bangladesh is shown in Fig. 1.

The main species exploited by these gear are Bombay duck, hairtail, croaker, cat fish, lizard fish, etc., and among the marine shrimp species, *Penaeus monodon, P. indicus, P. merguiensis, Metapenaeus monoceros, M. brevicornis, Parapenaeopsis stylifera, P. sculptilis,* etc. Out of the total marine catch (i.e. 294 000 metric tonnes) the artisanal fisheries alone contribute about 95%, of which 10% by the estuarine set bagnet, 19% by marine set bagnet, 1.5% by trammel net, 4% by bottom longline, 57% by gillnet and 3.5% by other gear.

According to the frame survey which was carried out by the Fisheries Resource Survey System (FRSS) of the Department of Fisheries (DOF) during 1984-85 a total of 17 331 non-mechanized and mechanized boats were found in operation in the marine artisanal fishery sector. Of these 3 317 were reported to be mechanized and 14 014 non-mechanized. According to a survey by the marine wing of the DOF, currently about 6 000 mechanized boats are now in operation of which 4 000 are registered with the Mercantile Marine Department (MMD). However, from another estimate (Nuruzzaman, 1991), the number of traditional and motorized boats in the estuaries and coastal waters of Bangladesh are 20 000 and 12 700 respectively.

The following nets are used in the marine and coastal waters which play an important role in contributing to catches:

### *i) Estuarine set bagnets (ESBN)*

A set bagnet (or stow net) is a conical shaped net, which looks like a bottom trawl net but fixed at the bottom. The net is made up of four panels. The mesh size varies between 20 and 140 mm at the mouth and 5 and 22 mm at the codend. The length of the net varies from 8.5 to 41 m and the height of the mouth opening from 2 to 7 m. About 12 560 set bagnets were estimated to be in operation in the estuaries at depths ranging from 3 to 10 m (BOBP, 1993).

The nets are classified into four, according to size based on the measurements of the mouth opening, as shown below:

| Gear Size Category | Width of Mouth (m) | Area of Mouth ($m^2$) |
|---|---|---|
| G1a | <6 | <15 |
| G1b | 6 – 10 | 15 – 50 |
| G1c | 10 – 15 | 50 – 90 |
| G1d | >15 | >90 |

A total of about 185 species of finfish and shell fish were identified in the ESBN catches. These included 15 penaeid shrimp, 152 finfish and 18 other fauna. The major shrimp species like tiger shrimp (*Penaeus monodon*), white shrimp (*P. indicus*), brown shrimp (*Metapenaeus monoceros, M. brevicornis, M. spinulatus*), pink shrimp (*Parapenaeus sculptilis, P. stylifera*), etc., including some other fish species like Bombay duck (*Harpadon nehereus*), hairtail (*Lepturacanthus savala*), croaker/jewfish, promfret (*Pampus argenteus*), grunter (*P. hasta*), etc., were also caught by the net. The annual average catch rate (kg/haul) of shrimp, finfish and others were 1.50, 3.36 and 12.7 respectively (BOBP 1993).

The annual total production of all the species combined was estimated to be 75 312 metric tonnes from the ESBN fishery. The total production of penaeid shrimp from different coastal districts in the ESBN fishery was estimated to be 7 746 metric tonnes as shown below:

| Gear Class | Districts | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | Cox's Bazar | Chittagong | Noakhali | Patuakhali | Bagerhat | Satkhira | |
| G1a | | 24 | 85 | 261 | | 72 | 442 |
| G1b | 776 | 25 | 53 | 954 | 18 | 86 | 1 912 |
| G1c | 4 638 | | | 502 | 178 | | 5 318 |
| G1d | | | | | 74 | | 74 |
| Total | 5 414 | 49 | 138 | 1 717 | 270 | 158 | 7 746 |

### *ii) Marine set bagnet (MSBN)*

This net is similar to ESBN and the operational procedure is also similar to that of ESBN, but the mesh sizes of MSBN are normally a little bigger compared to ESBN. The length of this net varies from 10 to 40 m and the mesh size at the codend from 12 to 25 mm. This net is operated during the dry season at depths of 10 to 30 m from the island bases. The total number of MSBN found to operate was 3 852. The classification of MSBN according to size is shown below:

| Gear Size Category | Width of Mouth (m) | Area of Mouth ($m^2$) |
|---|---|---|
| G1a * | <6 | <15 |
| G1b * | 6 – 10 | 15 – 50 |
| G1c** | 10 – 15 | 50 – 90 |
| G1d ** | >15 | >90 |

* Estuarine year round operation, ** Seasonal operation.

### *iii) Shrimp seed collection and by-catch (PN)*

Fine-mesh push nets, fixed bagnets and dragnets are used along the coastline for harvesting post larvae of *Penaeus monodon*. The total number of fry collection gear were estimated as 198 770 in 1989-90. Eighty-three types of organisms were identified in the catch composition of the shrimp fry collection

gear. Species composition in the by-catch of shrimp fry collection gear are shown in Table 3. The total annual catch of *P. monodon* fry is approximately 2 034 million. Total number of organisms (except tiger shrimp) caught by the shrimp seed collection gear were estimated to be almost 200 000 million in 1989-90 which were discarded on the bank. According to a survey conducted by DOF/BOBP during November 1989 to October 1990 in the four coastal districts about 300 000 people, including women and children, were involved in the collection of shrimp seeds.

*iv) Beach seine (BS)*

The beach seine is an encircling net operated from the beach in the shallow water. It is used along the coast, mainly concentrated in the Teknaf – Cox's Bazar area. The species caught in these nets are jewfish, anchovies, clupeids and small shrimp. There are about 558 beach seines operated in the coastal area of Bangladesh. The total production by the beach seine fishery in 1988-89 was estimated to be 8 080 metric tonnes. The average total catch rate (kg/day/net) for all species combined is estimated to 84 kg in the estuary and 213 kg along the coast.

*v) Gillnets (GN)*

Among the five types of gillnets, most are small mesh drift gillnets (SMD). The average mesh size of the gillnet (SMD) is 90 mm which is operated within 15-40 m depths. The principal catch of the net is *Hilsa ilisha* which contributed 49% to the total marine catch. This net also catches tuna, mackerel, sharks, etc., as by-catch. The annual average catch rate of all the species combined is estimated at 231 kg/day/boat.

The average mesh size of the large mesh drift gillnet (LMD) is 200 mm, which is operated within 15-40 m depths. The targeted species of this net is Indian salmon (*Polynemus indicus*). This net also catches grunter, shark, tuna, mackerel, etc., as by-catch. The annual average catch rate of all the species combined is estimated at 110 kg/day/boat.

*vi) Trammel net (TN)*

Trammel nets are three-folded type of gillnets targeting, when drifting on the bottom, penaeid shrimp but also catch valuable finfish species. These nets have recently been introduced in the country and their operation is concentrated along the Cox's Bazar-Teknaf coast. The mesh size at the inner wall of the net is 40-45 mm and made of nylon twine. This gear is operated by row boats within the depth range of 5-15 m. Major species caught by this net are white, tiger and brown shrimp, croakers, Bombay duck, catfish, etc. Adult fish are caught and this net is therefore considered to be harmless to the resource.

*vii) Bottom longlines (BLL)*

Bottom longlines are operated at the depth of 20-30 m, i.e. 20 km beyond the coastline, mainly from the Cox's Bazar base. These are operated by 6-16 HP mechanized boats. The targeted species are jewfish and croakers, but other species like salmon, catfish, threadfin bream, etc., are also caught. The species of fish caught by this gear are mostly at the adult stage and so the gear has no adverse affect on the resources.

*viii) Other gear*

There are several other fishing gear used in the estuaries of Bangladesh such as cast net, trap, harpoon, etc., for subsistence fishing and a few for part-time fishing by the fisherfolk living along the sea coast.

## 5. HISTORY OF THE TRAWL INDUSTRY IN BANGLADESH

Just after independence of the country the Bangladesh Fisheries Development Corporation (BFDC) initiated deep sea trawling commercially in 1972 with 10 trawler fleets received as a grant from the then Soviet Union. Different survey works revealed the satisfactory level of stocks of shrimp and fish in the EEZ of Bangladesh. Both local and foreign investors became interested in investing in fishing in the marine sector from the mid-1970s. During 1976-86, 114 trawlers were imported for local private ownership or joint ventures with Thailand including on the "Pay as you Earn" (PAYE) scheme against

**TABLE 3. Species composition in shrimp fry collecting gear; Push net and fixed Bagnet (% of numbers)**

| Species/Group name | Pushnet | | | | | Fixed bagnet | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Teknaf | Cox's bazar | Patua-khali | Khulna | Satkhira | Cox's bazar | Patua-khali | Khulna | Satkhira |
| Targeted Species | | | | | | | | | |
| *Penaeus monodon* (Tiger Shrimp) | 2.3 | 4.0 | 0.5 | 0.2 | 0.5 | 1.8 | 0.3 | 0.1 | 0.7 |
| Non-targeted Species | | | | | | | | | |
| *P. indicus* (Indian White Shrimp) | 7.7 | 9.6 | 0.0 | 0.0 | 0.0 | 49.9 | 0.6 | 0.0 | 0.0 |
| *Metapenaeus monoceros* (Brow Shrimp) | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.4 |
| *M. brevicornis* (Yellow Shrimp) | 0.0 | 0.0 | 1.6 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 0.2 |
| *Parapenaeopsis stylifera* (Kiddi Shrimp) | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 0.1 |
| *P. sculptilis* (Rainbow shrimp) | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| Other penaeids (Other shrimp) | 0.0 | 20.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| **Penaeids shrimp** | **7.7** | **30.3** | **1.7** | **0.0** | **6.2** | **50.0** | **0.7** | **0.2** | **1.0** |
| *Palaemon styliferus* (Roshana Prawn) | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 |
| *Macrobracium sp.* (Prawn) | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 |
| *Macrobracium sp.* (Other River Prawn) | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 |
| Other caridean (Other Prawn) | 0.1 | 3.1 | 42.2 | 10.6 | 19.6 | 0.6 | 5.9 | 16.8 | 18.3 |
| **Caridean shrimp** (Nonpenaeid shrimp) | **0.1** | **3.1** | **42.2** | **11.1** | **19.6** | **0.6** | **6.2** | **17.4** | **18.6** |
| *Eleutheronema tetradactylum* (Threadfin) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | |
| *E. thoracata*(Threadfin) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *A. miops* | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *C. dussumieri* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| *Cynoglossus sp.* (Tonguesole) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| *Anguilla*(Eel) | 0.2 | 0.3 | 0.0 | 0.0 | 1.4 | 0.0 | 0.1 | 0.0 | 0.7 |
| *G.griseus* | 0.1 | 1.7 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.3 | 1.2 |
| *Gobiidae* (Goby) | 0.0 | 0.0 | 0.0 | 2.3 | 0.5 | 1.1 | 0.0 | 0.6 | 2.2 |
| *Hemiramphus* sp.(Halfbeak) | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | - | - | - | - |
| *Sciaenidae*(Croaker) | 0.3 | 0.5 | 0.9 | 0.0 | 8.3 | 0.0 | 0.0 | 0.0 | 0.5 |
| *Lates calcarifer*(Giant Perch) | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| *Leiognathus* sp.(Ponyfish) | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| *Mugilidae*(Mullet) | 0.1 | 0.1 | 0.0 | 2.0 | 0.2 | 0.6 | 0.0 | 0.0 | 0.2 |
| *Pomadasys maculatus*(Slipmouth) | 0.9 | 1.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 |
| *Setipina* sp. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.1 |
| *Stolephorus tri* (Anchovy) | 0.0 | 2.3 | 0.0 | 8.2 | 0.1 | 4.9 | 13.9 | 1.7 | 0.1 |
| *Sardinella* sp.(Sardine) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 |
| *Sillago* sihama (Whiting) | 10.4 | 12.8 | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 |
| *Therapon* sp.(Therapon) | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| Other finfish larvae | 0.1 | 10.3 | 0.7 | 3.0 | 0.5 | 5.6 | 0.6 | 0.0 | 1.6 |
| **Finfish larvae** | **12.8** | **32.0** | **1.7** | **15.6** | **11.1** | **15.4** | **14.6** | **3.2** | **7.4** |
| Jellyfish | 5.4 | 7.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| *Squilla* | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.7 | 0.4 | 0.0 | 0.5 |
| Crab | 6.8 | 2.8 | 5.9 | 0.0 | 1.1 | 24.3 | 55.5 | 18.5 | 22.2 |
| *Acetes* (Sergestid shrimp) | 16.8 | 0.6 | 12.8 | 0.1 | 1.5 | 0.4 | 0.8 | 1.5 | 4.7 |
| Other zooplankton | 47.6 | 19.3 | 35.2 | 73.0 | 59.9 | 6.8 | 21.4 | 59.1 | 44.9 |
| **Palnkton + other organisms** | **77.1** | **30.6** | **53.9** | **73.1** | **62.6** | **32.7** | **78.2** | **79.1** | **72.3** |

**Note** : Species listed with zero percentage occur with percentage values below 0.1%. — = not found

**Source** : BOBP/WP/89

the 250 imported trawlers permitted by the Government. At that time the trawler fishery was declared as an "Open Industry" by the Government and a large number of trawlers were permitted to fish in the EEZ of Bangladesh. In that situation many unauthorized trawlers came to Bangladesh's territorial waters and started fishing. This resulted in heavy pressure on the marine fisheries resources. To face this negative situation and for the sake of conservation of marine resources the Government promulgated "The Marine Fisheries Ordinance"and "Marine Fisheries Rules"in 1983 and also some administrative orders (Appendixes IV-VIII). Upon implementation of the ordinance and rules the trawlers, which were engaged in illegal fishing, fled from the Bangladesh waters and the situation came under control. In 1985, the Government constituted a high power committee to investigate the total number of trawlers in operation, 73 trawlers were found at that time. On the basis of expert opinion, the committee recommended that the 73 trawlers be allowed to operated in the EEZ of Bangladesh. Since then no new trawlers have been permitted to fish. At present 68 trawlers are engaged in fishing of which 45 trawlers are shrimp and the rest are fish or mixed trawlers.

## 6. PRODUCTION OF FISH FROM DIFFERENT SOURCES IN BANGLADESH

Production of fish from different sources during the years 1993-94 to 1996-97 are given below:

| Year | Total Country Production (metric tonnes) | Total MarineProduction (metric tonnes) | Industrial Production (metric tonnes) | Artisanal Production (metric tonnes) |
|---|---|---|---|---|
| 1993-94 | 1 090 610 | 253 000 | 12 454 | 240 546 |
| 1994-95 | 1 170 365 | 265 000 | 11 720 | 253 280 |
| 1995-96 | 1 257 940 | 279 000 | 11 959 | 267 041 |
| 1996-97 | 1 306 739 | 274 704 | 13 564 | 261 140 |

Species composition and percentage of total marine fish catch are shown below:

| Year | Hilsa | Bombay Duck | Indian Salmon | Promfret | Jewfish | Catfish | Shark & Rays | Other marine fish | Shrimp | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1992-93 | 49.15 | 8.42 | 0.88 | 1.30 | 4.58 | 5.23 | 1.59 | 19.29 | 9.57 | 100 |
| 1993-94 | 47.88 | 7.88 | 0.96 | 1.33 | 4.91 | 4.51 | 1.66 | 22.35 | 8.52 | 100 |
| 1994-95 | 48.79 | 7.60 | 0.55 | 1.28 | 4.10 | 4.26 | 1.55 | 24.19 | 7.69 | 100 |
| 1995-96 | 46.96 | 6.53 | 0.61 | 1.66 | 4.35 | 4.65 | 1.52 | 23.94 | 9.77 | 100 |

Annual total catch by different marine fisheries are shown in Table 4.

## 7. SHRIMP CATCH, BYCATCH, AND CATCH EFFORT DATA FROM SHRIMP TRAWLERS

The catch and effort data of the shrimp trawlers are regularly collected in a prescribed manner developed with the help of the UNDP/FAO project BGD/80/025 (Appendixes II and III). The trawl operators provide information according to the log sheets which are collected by the inspectors of the Marine Fisheries Office. This information allows to determine the catch per unit of effort. The table below shows the catch rate by the commercial trawlers during the years 1992-93 to 1998-99.

Among the commercial shrimp, important groups like the white and brown show a definite declining trend and the tiger, although not yet recovered to the 1992-93 level, showed signs of improvement during 1996-97, but declined again in 1997-98.

**TABLE 4. Annual Total Catch of Marine Fisheries, 1996-97 and 1997-98**

| Type of Fishing | Number of Craft (Trawler/Boat) | | Number of Unit (Gear/Net) | | Catch in Metric Ton | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Shrimp | | Fish | | Total | |
| | 96-97 | 97-98 | 96-97 | 97-98 | 96-97 | 97-98 | 96-97 | 97-98 | 96-97 | 97-98 |
| A. Industrial | | | | | | | | | | |
| *(1) Trawl fishing* | | | | | | | | | | |
| a) Shrimp trawler | 41 | 41 | - | - | 3508 | 2419 | 4200 | 5714 | 7741 | 8133 |
| b)Fish trawler | 13 | 13 | - | - | 29 | 25 | 5794 | 7115 | 5823 | 7140 |
| **Total Industrial** | **54** | **54** | **-** | **-** | **3537** | **2444** | **10027** | **12829** | **13564** | **15273** |
| B. Artisanal | | | | | | | | | | |
| *(1) Gill net fishing* | | | | | | | | | | |
| a) Mechanized | 2880 | 2880 | 2880 | 2880 | - | - | 127725 | 118911 | 118911 | 118911 |
| b) Non-mechanized | 3509 | 3509 | 3509 | 3509 | - | - | 28639 | 36747 | 36747 | 36747 |
| **Sub-total** | **6389** | **6389** | **6389** | **6389** | **-** | **-** | **156264** | **155658** | **155658** | **155658** |
| *(2) Set beg net fishing* | | | | | | | | | | |
| a) Seasonal : | | | | | | | | | | |
| (i) M.B | 182 | 182 | 5400 | 5400 | 8156 | 8564 | 45395 | 47665 | 53551 | 56229 |
| (ii) N.M.B | 2680 | 2680 | | | | | | | | |
| b) All season (N.M.B) | 4590 | 4590 | 7215 | 7215 | 11754 | 12342 | 13086 | 13052 | 24840 | 25394 |
| **Sub-total** | **7452** | **7452** | **12615** | **12615** | **19910** | **20906** | **58481** | **60717** | **78391** | **81623** |
| (3) Jew long line fishing | | | | | | | | | | |
| a) Mechanized | 255 | 255 | 1121 | 1121 | | | 9899 | 10394 | 9899 | 10394 |
| b) Non-mechanized | 1127 | 1127 | 963 | 963 | | | | | | |
| c) Other long line | | | | | | | | | | |
| **Sub-total** | **1384** | **1384** | **2084** | **2084** | **-** | **-** | **9899** | **10394** | **9899** | **10394** |
| *(4) Trammel net fishing* | 500 | 500 | 500 | 500 | 340 | 357 | 3339 | 3506 | 3679 | 3863 |
| *(5) Other gears fishing* | 1608 | 1608 | 2222 | 2222 | 1031 | 1083 | 11776 | 4924 | 12807 | 6007 |
| Total Artisanal : | | | | | | | | | | |
| (i) M.B | 3317 | 3317 | 23810 | 23810 | 21281 | 22346 | 239859 | 235199 | 261140 | 257545 |
| (ii) N.M.B | 14014 | 14014 | 23810 | 23810 | | | | | | |
| Grand total (Industrial + Artisanal) | Trawler 54<br>(i) M.B 3317<br>(ii) N.M.B 14014 | | Gill 6389<br>SBN 12615<br>Long line 2084<br>Other 2222<br>Trammel 500 | | 24818 | 24790 | 249886 | 248028 | 274704 | 272818 |

M.B. Mechanized boat
N.M.B. Non-mechanized boat
SBN Set beg net
Source : Department of Fisheries

| Year | Type of Trawler | No. of Trawlers | Total fishing days | Shrimp (HO) catch in metric tonnes | | Fish catch in Metric tonnes | |
|---|---|---|---|---|---|---|---|
| | | | | Total | Catch/ day | Total | Catch/ day |
| 1992-93 | Shrimp | 37 | 6 588 | 3 903 | 0.59 | 5 49 | 0.83 |
| | Fish | 12 | 1 545 | 258 | 0.18 | 2 54 | 1.65 |
| | **Total** | **49** | **8 133** | **4 188** | **0.51** | **8 03** | **0.99** |
| 1993-94 | Shrimp | 40 | 7 113 | 3 453 | 0.48 | 5 67 | 0.80 |
| | Fish | 11 | 1 228 | 27 | 0.02 | 3 30 | 2.69 |
| | **Total** | **51** | **8 341** | **3 480** | **0.42** | **8 97** | **1.06** |
| 1994-95 | Shrimp | 43 | 6 691 | 2 391 | 0.36 | 4 89 | 0.73 |
| | Fish | 14 | 1 354 | 25 | 0.02 | 4 40 | 3.25 |
| | **Total** | **57** | **8 045** | **2 416** | **0.30** | **9 29** | **1.16** |
| 1995-96 | Shrimp | 41 | 6 502 | 3 554 | 0.55 | 3 80 | 0.58 |
| | Fish | 12 | 1 432 | 34 | 0.02 | 4 56 | 3.19 |
| | **Total** | **53** | **7 934** | **3 588** | **0.45** | **8 37** | **1.06** |
| 1996-97 | Shrimp | 41 | 6 814 | 3 508 | 0.51 | 4 23 | 0.62 |
| | Fish | 14 | 1 658 | 28 | 0.02 | 5 79 | 3.50 |
| | **Total** | **55** | **8 470** | **3 536** | **0.41** | **10 02** | **1.18** |
| 1997-98 | Shrimp | 48 | 7 044 | 2 419 | 0.34 | 5 71 | 0.81 |
| | Fish | 13 | 1 856 | 25 | 0.01 | 7 51 | 4.05 |
| | **Total** | **61** | **8 900** | **2 444** | **0.27** | **13 22** | **1.49** |
| 1998-99 | Shrimp | 44 | 7 624 | 3 705 | 0.49 | 5 17 | 0.68 |
| | Fish | 15 | 2 124 | 357 | 0.17 | 6 66 | 3.14 |
| | **Total** | **59** | **9 748** | **4 062** | **0.42** | **11 83** | **1.21** |

The percentage composition of different commercial shrimp for the last 6 years are given below:

| Year | Tiger | White | Brown | Others |
|---|---|---|---|---|
| 1992-93 | 12.30 | 7.70 | 60.60 | 19.40 |
| 1993-94 | 8.91 | 13.33 | 50.86 | 26.90 |
| 1994-95 | 12.49 | 8.01 | 55.70 | 23.80 |
| 1995-96 | 7.91 | 9.15 | 57.85 | 25.09 |
| 1996-97 | 9.58 | 6.25 | 59.83 | 24.31 |
| 1997-98 | 8.61 | 5.44 | 55.49 | 30.46 |

## 8. ESTIMATION OF CATCH COMPOSITION AND CATCH RATES OF TRAWL FISHERY FOR THE YEAR 1998-90 AS CASE STUDY

There is no recent study which can be used to elaborate the catch composition, by-catch, production trends by the trawl fishery. Data from one study during 1991-92 and from trawl surveys in 1988-89 (by R.V. ANUSANDHANI and R.V. MACHHRANGA research vessels of the Department of Fisheries) were used to estimate catch and size compositions for the respective trawl nets: by fishing grounds, depth ranges and seasons covered by the commercial shrimp and finfish trawlers. Catch data from the commercial fleets up to 1990-91 were compiled for routine catch estimates and were used along with the detailed percentage of catch compositions from the survey data to estimate catch rate and production of individual species. The situation has changed considerably during the last few years as many of the fish or invertebrates like cuttlefish, squid, octopus, etc., became commercially important due to market expansion and there has been an increasing acceptability of marine fish. However, the study can still be used to understand the trawl fishery of Bangladesh. Percentage of catch composition of shrimp and fish including monthly and yearly catch data for the years 1992 to January 1999 are shown in Tables 5 and 6.

**TABLE 5. Statement showing the percentage composition of different species of shrimp by the commercial double rigger shrimp trawlers**

- **All shrimp are in Head-on**
- **Weight are in kg**

| Year | | Tiger | White | Brown | Other | Total |
|---|---|---|---|---|---|---|
| 1992-93 | Amount | 458202 | 284597 | 2306674 | 646243 | 3695689 |
| | Percentage | 12.39% | 7.70% | 62.41% | 17.48% | |
| 1993-94 | Amount | 289448 | 436325 | 1656510 | 854071 | 3236654 |
| | Percentage | 8.94% | 13.48% | 51.17% | 26.39% | |
| 1994-95 | Amount | 383837 | 184042 | 1250482 | 503827 | 2222188 |
| | Percentage | 12.77% | 8.28% | 56.27% | 22.67% | |
| 1995-96 | Amount | 267332 | 310869 | 1941737 | 817849 | 3337787 |
| | Percentage | 8% | 9.31% | 58.17% | 24.50% | |
| 1996-97 | Amount | 316080 | 207373 | 1985612 | 809262 | 3318327 |
| | Percentage | 9.52% | 6.24% | 59.83% | 24.38% | |
| 1997-98 | Amount | 196928 | 124346 | 1268833 | 696554 | 2286661 |
| | Percentage | 8.61% | 5.43% | 55.48% | 30.46% | |

**TABLE 6. Year-wise catch data from the trawlers operating in the Bay of Bengal**

| Year | Class of Trawler | No. of Trawler | Total Fishing Days | Shrimp (H.O.) catch in mt | | Fish catch in mt. | | remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Total | Catch/day | Total | Catch/day | |
| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
| 1985-86 | Shrimp | 31 | 5,794 | 3,716 | 0.64 | 2,317 | 0.040 | |
| | Mixed | 8 | 1,463 | 315 | 0.22 | 4,478 | 3.06 | H.O- |
| | Fish | 6 | 320 | | | 1,022 | 3.35 | head on |
| | Total | 45 | 7,577 | 4031 | 0.53 | 7,867 | 1.04 | basis |
| 1986-87 | Shrimp | 31 | 6,429 | 4,178 | 0.65 | 3,099 | 0.48 | Mixed |
| | Mixed | 8 | 1,811 | 304 | 0.17 | 3,336 | 1.84 | Trawlers |
| | Fish | 10 | 540 | 07 | 0.01 | 1,433 | 2.65 | reclassifi |
| | **Total** | **49** | **8,780** | **4,489** | **0.51** | **7,868** | **0.90** | ed as |
| 1987-88 | Shrimp | 33 | 6,642 | 3,361 | 0.51 | 2,457 | 0.37 | shrimp |
| | Mixed | 8 | 1,274 | 173 | 0.14 | 2,858 | 2.24 | Trawlers |
| | Fish | 11 | 1,057 | 11 | 0.01 | 1,535 | 1.45 | (Total 8 |
| | **Total** | **52** | **8,973** | **3,545** | **0.40** | **6,850** | **0.76** | in Nos) |
| 1988-89 | Shrimp | 42 | 7,806 | 4,830 | 0.62 | 4,487 | 0.58 | in 1988- |
| | Fish | 8 | 617 | 32 | 0.05 | 931 | 1.51 | 89 |
| | **Total** | **50** | **8,423** | **4,862** | **0.58** | **5,418** | **0.64** | |
| 1989-90 | Shrimp | 44 | 7,394 | 3,134 | 0.42 | 6,157 | 0.83 | |
| | Fish | 08 | 990 | 1 | | 2,105 | 2.13 | |
| | **Total** | **52** | **8,384** | **3,135** | **0.37** | **8,262** | **0.99** | |
| 1990-91 | Shrimp | 42 | 5,658 | 3,652 | 0.65 | 3,526 | 0.62 | |
| | Fish | 12 | 721 | 44 | 0.06 | 1,532 | 2.13 | |
| | **Total** | **54** | **6,379** | **3,696** | **0.58** | **5,058** | **0.79** | |
| 1991-92 | Shrimp | 46 | 5,529 | 2,621 | 0.47 | 4,747 | 0.86 | |
| | Fish | 14 | 1,421 | 281 | 0.09 | 1,974 | 1.39 | |
| | **Total** | **60** | **6,950** | **2,902** | **.040** | **6,721** | **0.96** | |
| 1992-93 | Shrimp | 37 | 6,588 | 3,903 | 0.59 | 5,494 | 0.83 | |
| | Fish | 12 | 1,545 | 285 | 0.18 | 2,545 | 1.65 | |
| | **Total** | **49** | **8,133** | **4,188** | **0.51** | **8,039** | **0.99** | |
| 1993-94 | Shrimp | 40 | 7,113 | 3,453 | 0.48 | 5,670 | 0.80 | |
| | Fish | 11 | 1,228 | 27 | 0.02 | 3,305 | 2.69 | |
| | **Total** | **51** | **8,341** | **3,480** | **0.42** | **8,975** | **1.06** | |
| 1994-95 | Shrimp | 41 | 6,691 | 2,391 | 0.36 | 4,894 | 0.73 | |
| | Fish | 12 | 1,354 | 25 | 0.02 | 4,404 | 3.25 | |
| | **Total** | **53** | **8,045** | **2,416** | **0.30** | **9,298** | **1.16** | |
| 1995-96 | Shrimp | 41 | 6,502 | 3,554 | 0.55 | 3,803 | 0.58 | |
| | Fish | 12 | 1,432 | 34 | 0.02 | 4,568 | 3.19 | |
| | **Total** | **53** | **7,934** | **3,588** | **0.45** | **8,371** | **1.06** | |
| 1996-97 | Shrimp | 41 | 6,814 | 3,508 | 0.51 | 4,233 | 0.62 | |
| | Fish | 14 | 1,656 | \28 | 0.02 | 5,793 | 3.50 | |
| | **Total** | **55** | **8,470** | **3,536** | **0.41** | **10,026** | **1.18** | |
| 1997-98 | Shrimp | 48 | 7,044 | 2,419 | 0.34 | 5,714 | 0.81 | |
| | Fish | 13 | 1,856 | 25 | 0.01 | 7,515 | 4.05 | |
| | **Total** | **61** | **8,900** | **2,444** | **0.27** | **13,229** | **1.49** | |
| 1998-99 | Shrimp | 44 | 7,624 | 3,705 | 0.49 | 5,178 | 0.68 | |
| | Fish | 15 | 2,124 | 357 | 0.17 | 6,661 | 3.14 | |
| | **Total** | **659** | **9,748** | **4062** | **0.42** | **11,839** | **1.21** | |

**Catch composition of shrimp trawl net**

Eleven species of shrimp including spiny lobsters were found in the shrimp trawl catches, 15 species of commercially valuable finfish, 38 species classified as by-catch, 28 species classified as trash fish and about 8 small size other commercially important species which were usually discarded.

Major species of penaeid shrimp were brown shrimp, tiger shrimp, Indian white shrimp and banana shrimp. Noteworthy commercially high-valued finfish were tigertooth croaker, blotched croaker, Bombay duck, lizard fish, goat fish and ilisha shad. Pony fish, small size lizard fish, goat fish, croakers, tripod fish, puffer fish, squilla, swimming crab and small molluscs and flatfish were considered as trash fish. Cuttlefish, squid octopus, shark and ray are also discarded as by-catch.

The number of species or groups of species (No.) of the above mentioned categories with their percentage by weight caught by the shrimp trawl net at different depth ranges are shown below.

| Categories | <30 m depth range | | 30-80 m depth range | |
|---|---|---|---|---|
| | Approx. No. | Percentage of catch (by wt) | Approx. No. | Percentage of catch (by wt) |
| Shrimp + lobster | 11 | 1.5 | 11 | 4.8 |
| Commercial fish | 15 | 10.0 | 15 | 12.0 |
| By-catch | 31 | 56.0 | 38 | 48.0 |
| Trash fish | 18 | 20.5 | 28 | 26.0 |
| Others discarded | 8 | 12.0 | 8 | 9.2 |
| **Total** | **83** | **100.0** | **100** | **100.0** |

From the catch records a noticeable decline in the relative proportion of white shrimp and an increase in the proportion of brown and tiger shrimp were found in the 30-80 m depth ranges compared to those in the depth range below 30 m. Among the commercially valuable finfish species, an increase in the relative proportion of hairtail, mackerel and silver pomfret were evident in the depth range 30-80 m. Croaker continues to maintain a relatively high proportion both in the < 30 m and 30-80 m depth range. Among the by-catch species, threadfin bream and tongue soles were significantly more in the 30-80 m depth ranges compared to <30m depth. The proportion of trash fish was also found to increase in the catch. Ponyfish and silver bidders were conspicuous among the trash fish. Occurrence of catch of 'other'species discarded were more or less similar at different depth ranges.

**Catch composition of fish trawl net**

All species caught by the shrimp trawl in the 30-80 m depth ranges were also observed in the finfish trawl catches. Smaller penaeid shrimps (*Metapenaeus spp.* and *Parapenaeopsis spp.*) were caught at relatively higher proportions in <30 m depth. In the 30-80 m depth range, tiger and brown shrimp were relatively more abundant. Though most of the penaeid shrimp were also caught in the fish trawl, their percentage of catch were much less compared to that of shrimp trawl catches.

Among the commercial fish catches, croaker occurre occasionally, unlike in the shrimp trawl catches, but Indian salmon, grouper, grunter, pomfret and ribbonfish catches were relatively higher even in the shallow waters (<30 m). In the 30-80 m depth, ribbonfish formed a very significant portion in the catch. The by-catch category included species which also increased with the fishing depth: Indian mackerel and false trevally in the <30m depth and seabream in the 30-80 m depth were significant additions in the fish trawl catches.

The percentage of trash fish in the catch in depth less than 30 m was significantly higher than in greater depth. Approximate number of categories caught by trawl net at different depths and percentages are shown below:

| Categories | <30 m depth range | | 30-80 m depth range | |
|---|---|---|---|---|
| | Approx. No. | Percentage of catch (by wt) | Approx. No. | Percentage of catch (by wt) |
| Shrimp + lobster | 6 | 0.6 | 11 | 0.5 |
| Commercial fish | 20 | 9.0 | 20 | 17.0 |
| By-catch | 43 | 48.0 | 50 | 55.0 |
| Trash fish | 24 | 37.0 | 24 | 24.0 |
| Others discarded | 8 | 5.5 | 8 | 3.5 |
| **Total** | **101** | **100.0** | **113** | **100.0** |

**Catch rates of shrimp by shrimp trawl net**

In the shrimp grounds of <30 m depth, the annual mean catch rate was estimated to be 5.7 kg/hour and it was 7.5 kg/hour in the 30-80 m depth. The peak months for different varieties of shrimp at different depth are shown below:

| Categories | <30 m depth range | 30-80 m depth range |
|---|---|---|
| a) All shrimp | April-July | August, December, February (secondary peak) |
| b) Brown shrimp | April-July | August-February |
| c) White shrimp (sporadic occurrences) | July | January, July and August |
| d) Other penaeids | August | December-January |

**Catch rates of fish by shrimp trawl net**

The annual mean catch rates of different categories of fish in the shrimp trawl catches, peak months and main contributors to the peak catches at different depths are summarized below:

| Categories | <30 m depth range | | | 30-80 m depth range | | |
|---|---|---|---|---|---|---|
| | Annual catch Rate Kg/hour | Peak Months (catch rate/ kg/hour) | Major Contributors | Annual catch Rate kg/hour | Peak Months (catch rate kg/hour) | Major Contributors |
| High value finfish | 3.3 | July (114) | Grunt | 2.3 | July-August (30) | Croaker |
| Low value finfish | 188 | April (303)<br>July (281) | Croaker, catfish, lizard fish, tongue sole, small grunt | 67 | February (100)<br>July (100) | Threadfin<br>Bream |
| Trash fish | 68 | April (186) | | 34 | April (80) | |
| Other discards | 39 | | | 19 | | |

**Catch rates of shrimp by fish trawl net**

Penaeid shrimp catches were extremely low in the finfish trawls operated in <30 m depth (0.7 kg/30 min) and >30 m depth (1.3 kg/hour). With such trawls there is no record of shrimp catch in most of the year

**Catch rates of fish by fish trawl net**

The mean annual catch rates for different categories of finfish by the trawlers and the peak months of the catch rates at different depths are summarized below:

| Categories | <30 m depth range | | 30-80 m depth range | |
|---|---|---|---|---|
| | **Annual catch rate (kg/hour)** | **Peak months (catch rate kg/hour)** | **Annual catch Rate (kg/hour)** | **Peak months (catch rate kg/hour)** |
| a) High value finfish | 16.4 | February(17)<br>May (17)<br>September (17) | 24.7 | March (40)<br>August (25) |
| b) Low value by-catch | 75 | July (232)<br>March (105) | 75 | September (208) |
| c) Trash fish & other discards | 69 | | 48 | |

The predominant finfish variations at different depth ranges are as follows:

| **Depth kg/30 min haul** | **10-20 m 119** | **20-50 m 84** | **50-80 m 53** | **80-100 m 30** |
|---|---|---|---|---|
| Predominant Finfishes | Croaker, Catfish | Croaker, catfish | Catfish Goatfish | Threadfish/bream, mackerel |
| | Ray, Grunt | Polyfish, ribbonfish | Threadfin /bream, scad | Lizardfish, scad scad |

**Annual variation in the catch rate of the penaeid shrimp**

The annual variation in the catch rate of the commercial categories of penaeid shrimp (tiger, white, brown and others) from the shrimp trawl catches was recorded for the period 1981-82 to 1990-91 and are shown in Fig. 2.

The annual catch rate for all the penaeid shrimp combined shows year to year fluctuations, but an increasing trend was observed in the years 1981-82 to 1990-91. Annual catch rate of tiger shrimp showed less fluctuations, but a declining trend was evident with an average of 4.5 kg/hour until 1984-85 and a catch of 3.7 kg/hour thereafter, approximately 17% decline between the years 1981-82 and 1990-91. The white shrimp and the banana shrimp showed a slight increase in the annual average catch rate until the mid 1980s (1.5 kg/hour), but exhibited an noticeable decline (0.7 kg/hour) in the later years, approximately 50%, decline between 1981-82 and 1990-91. The brown shrimp had the highest catch rate with wide annual fluctuations and significantly increasing trend from 1980 (13.5 kg/hour) to 1990-91 (31 kg/hour), approximately a 130% gain. The small mixed or other shrimps (other *Metapenaeus spp* and non-penaeids such as *Solenocera spp.*) had a peak catch during the year 1984-85, which declined significantly thereafter but remained higher than the catch rates recorded between 1981-82 and 1983-84. These changes also indicate a significant change in the catch composition of penaeid shrimp in the trawl catches as shown below. Brown shrimp has become more important in the overall penaeid shrimp catch.

| **Shrimp** | **1980-81 (%)** | **1990-91 (%)** |
|---|---|---|
| Tiger | 21 | 10 |
| White | 14 | 4 |
| Brown | 58 | 77 |
| Others | 7 | 9 |
| **Total** | **100** | **100** |

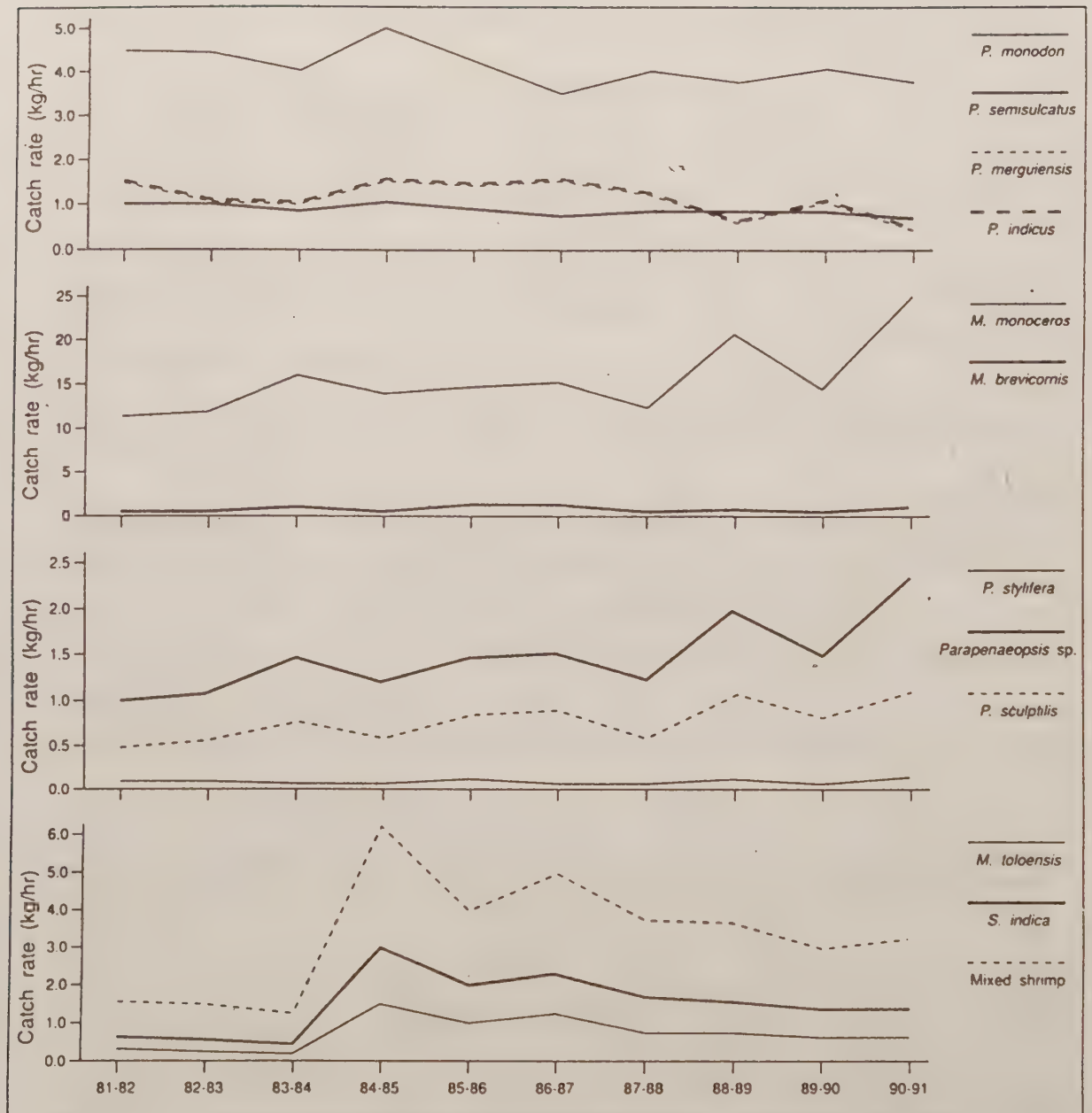



**Fig. 2 Annual variations in the catch rate (kg/hr) for the commercial penaeid shrimp during 1981-82**

The shrimp catch by the standardized fishing efforts for the last decade are given below:

| Year | Shrimp catch (t) | Standardized fishing efforts (No. of fishing days) | Catch rate (kg/fishing days) | Revenue in Tk. 1 000 000 |
|---|---|---|---|---|
| 1981-82 | 1 697 | 3 780 | 449 | 320 |
| 1982-83 | 3 120 | 7 020 | 444 | 580 |
| 1983-84 | 5 460 | 9 660 | 565 | 1 000 |
| 1984-85 | 5 518 | 8 160 | 676 | 1 030 |
| 1985-86 | 4 034 | 6 440 | 626 | 730 |
| 1986-87 | 4 488 | 6 930 | 648 | 830 |
| 1987-88 | 3 523 | 6 580 | 535 | 650 |
| 1088-89 | 4 8 93 | 6 940 | 705 | 900 |
| 1989-90 | 3 134 | 5 540 | 565 | 540 |
| 1990-91 | 3 430 | 4 500* | 762 | 650 |

* Efforts reduced due to loss/damage of trawlers during the cyclone in April 1991

**Production including discarded bycatch with percentage composition**

Using the catch data of the commercially important shrimp and finfish caught by the shrimp trawlers during the year 1989-90, the annual catch of the commercial categories of shrimp and fish were estimated to be 56 226.8 metric tonnes. Of which 2 714.8 metric tonnes (4.82%) was penaeid shrimp, 70.9 metric tonnes (0.13%) lobster, 6 898 metric tonnes (12.27%) high-value finfish, 26 568 metric tonnes (47.25%) low value by-catch, 14 534.9 metric tonnes (25.86%) trash fish and 5 439.4 metric tonnes (9.67%) other species. Among the total catches, Penaeid shrimp, lobster and high value finfish species, amounting to about 18% are retained and the rest of the catch which is low value by-catch, trash fish and other species amounting to about 82% are discarded at sea.

**Utilization of trash fish**

At present about 5-7% by-catch (low value small fish and other discards) of the total catch are landed. Some of these (about 2%) are exported by a few private companies after some value addition. The remainder is sold at the local markets.

## 9. ANALYSIS OF CATCH DATA INCLUDING BY-CATCH AND SIZE COMPOSITION OF CATCHES FROM THE SHRIMP TRAWLERS

**Analysis of 1 hour haul**

There is no detailed study and analysis for the catch of commercial shrimp trawls to indicate type and size composition of different species caught including by-catch. However to give an idea of what may occur in a commercial shrimp trawl, the detailed composition of the catch from one haul during a survey cruise (by the research vessel R.V. ANUSANDHANI) in the year 1997 is given in Table 7). The catch included two species of commercial shrimp, 1 species of lobster, 11 species of commercially valuable finfish including other shell fish. In addition to that 12 species of juveniles of commercially valuable fish and 15 species of adult small size fish were also caught and considered as trash. Two other fish species, *T. potoca* and trigger fish are also considered as true trash. Low value species and trashfish are generally discarded by the commercial shrimp trawlers (Table 8).

The catch which is analysed in reference also includes some macrobenthos species such as sponges, jelly fish, sand dollars, star fish, sea urchin, sea turtle, octopus, molluscs, sea anemone, sea cucumber, sea snake, sea weeds, coral, etc. These are commonly caught by the commercial fish and shrimp trawlers and are discarded as by-catch. The percentage composition and catch per unit of effort of these species were not studied in detail. Most of the above mentioned species, except the turtles and snakes, were somehow affected due to contact with the trawl net. The turtles and sea snakes can escape damage because of their strong exoskeleton and skin respectively.

**TABLE 7. Catch composition from shrimp trawl net in the Bay of Bengal by the research vessel R.V. Anusandhani (one hour haul at 45 m. depth) in January 1997**

| Sl.No. | Species | Weight (kg) | % | Length(cm) |
|---|---|---|---|---|
| A. | Commercial Shrimp. (Sub-total) | 01.70 | 1.94 | - |
| 1. | *Metapenaeus monoceros* | 1.5 | 1.71 | - |
| 2. | *M. toluensis* | 0.2 | 0.23 | - |
| B. | Lobster | 0.2 | 0.23 | - |
| C. | Commercial Fin-Fish/Others Sub-total) | 35.90 | 41.05 | |
| 1. | *Pampus argenteus* | 4.3 | 4.92 | - |
| 2. | Arius sp. (Cat fish) | 0.6 | 0.68 | - |
| 3. | *Upeneus sulphureus* | 7.0 | 8.00 | - |
| 4. | *Saurida tumbil* | 9.5 | 10.86 | - |
| 5. | *Lepturacanthus savala* | 5.0 | 5.72 | - |
| 6. | *Nemipterus japonicus* | 0.50 | 0.57 | - |
| 7. | *Chirocentrus dorab* | 2.0 | 2.29 | - |
| 8. | *Scomberomurus guttatus* | 0.3 | 0.34 | - |
| 9. | *Tongue sole* | 1.2 | 1.37 | - |
| 10. | Loligo spp. (Squid) | 1.50 | 1.71 | - |
| 11. | Sepia spp. (Cuttle fish) | 4.0 | 4.57 | - |
| | TOTAL (A+B+C) | 37.80 | 43.22 | - |
| D. | Trash Fish(Total = a+b+c) | 49.65 | 56.77 | - |
| a) | Juvenile species/group (Commercial) | 0 | 0 | - |
| 1. | *Upeneus sulphureus* | 2.0 | 2.29 | 10 |
| 2. | Croaker | 1.0 | 1.14 | 10 |
| 3. | Arius spp. (Cat fish) | 1.0 | 1.14 | 14 |
| 4. | *Lepturacanthus savala* | 2.0 | 2.29 | 14 |
| 5. | **Tongue sole* | 1.0 | 1.14 | 11 |
| 6. | *Drephane punctata* | 2.0 | 2.29 | 15 |
| 7. | *Bothidae | 2.5 | 2.86 | 9 |
| 8. | *Sepia spp. (Cuttle fish) | 1.0 | 1.14 | 5-9 |
| 9. | *Loligo spp. (Squid) | 0.4 | 0.46 | 6-9 |
| 10. | *Saurida tumbil* | 0.5 | 0.57 | 9 |
| 11. | *Nemipiterus japonicus* | 0.5 | 0.57 | 8 |
| 12. | Lobster | 0.25 | 0.28 | 7 |
| | Sub-Total | 14.15 | 16.18 | - |

**TABLE 8. Weight and percentage ofdifferent group of fishes among the trash fish**

| Trash Fish | Weight (Kg.) | % |
|---|---|---|
| a. True trash fish | 3.20 | 6.44 |
| b. Commercial juvenile species. | 14.15 | 28.50 |
| c. Adult species. | 32.30 | 65.05 |
| TOTAL | 49.65 | 100% |

## 10. IMPACT ON BIO-DIVERSITY AND ON ECOLOGICALLY SENSITIVE AREAS OF THE MARINE ECOSYSTEM

### 10.1 Impact of shrimp trawling on shrimp resources

Exploitation of marine shrimp resources in Bangladesh comprises mainly of five species of *Penaeus*, three species of *Metapenaeus* and two species of *Parapenaeopsis* genus. Among these, all of the genus, *Penaeus* in general and particularly *P. monodon* and *P. indicus*, are the most targeted species due to their higher market demand. Present shrimp trawling in marine waters is significantly concentrated for harvesting tiger shrimp (*Penaeus monodon*). Harvesting regimes of this species comprise three major stages, i.e. offshore trawling, inshore artisanal fishing and post-larval shrimp collection from the coastal waters. This multi-sectoral exploitation pressure, particularly on this species, has created a continuous declining trend over time which is shown in the table below. Depleted catches of this species is a sign that the stock may collapse in the near future.

It is noted that the offshore waters of Bangladesh possess the largest shrimping grounds among the South Asian nations but competition in commercial tiger shrimp trawling is definitively leading to a decreasing standing stock of shrimp.

Table below shows percentage of species composition of shrimp caught in the shrimp trawling:

| Year | P. monodon | P. indicus | M. monoceros | Small mixed shrimp |
|---|---|---|---|---|
| 1987-88 | 17.30 | 8.10 | 53.30 | 21.30 |
| 1988-89 | 11.27 | 6.90 | 65.40 | 12.43 |
| 1989-90 | 15.80 | 6.50 | 57.50 | 20.20 |
| 1990-91 | 9.79 | 2.79 | 72.08 | 15.34 |
| 1991-92 | 18.80 | 7.60 | 63.60 | 10.00 |
| 1992-93 | 12.30 | 7.70 | 60.60 | 19.40 |
| 1993-94 | 8.91 | 13.33 | 50.86 | 26.90 |
| 1994-95 | 12.49 | 8.01 | 55.70 | 23.80 |
| 1995-96 | 7.91 | 9.15 | 57.85 | 25.09 |
| 1996-97 | 9.58 | 6.25 | 59.83 | 24.39 |
| 1997-98 | 8.61 | 5.44 | 55.49 | 30.46 |

Source: Marine Fisheries Department, Chittagong.

### 10.2 Impact of trawling on marine living aquatic resources

No extensive work has been done to evaluate the effects of shrimp trawling on other marine aquatic resources and habitat, but some observation during the past two decades has shown that shrimp trawling has a negative impact on the marine fisheries resources. The most extensive damage is the wastage of resources when discarding by-catches. Extensive catch without consideration of breeding seasons effects the breeding cycles of fish and shrimp. Habitat destruction of the benthic flora and fauna was also noticed, as the trickler chains of the shrimp trawl nets are continuously dragging on the bottom of the sea. These effects of trawling on the marine resources are described below in more detail:

#### i) Wastage of fisheries resources

It is estimated that 80% of the fish caught by shrimp trawlers is discarded at sea. The amount of by-catch discarded was estimated to be 35 000-40 000 metric tonnes. This wastage is alarming in a country like Bangladesh where there is a serious scarcity of fish to meet the national demand. Reasons for by-catch discards are identified as follows:

**Technical:**

- Limited chilling or cold storage capacity, especially in smaller trawlers.
- Possibility of heat shock damage to high value shrimp by retention of large volumes of fish, and
- Difficulties related to transfer to other vessels at sea.

**Financial:**

- Low price of landed by-catch vis a vis shrimp;
- Lack of market development for value added product options, and
- Lack of marketing infrastructure

**Institutional:**

- Trawler owners are entirely motivated by high returns from shrimp and are not interested in landing by-catch.

There is a lack of policy regarding the discard issue and a systematic observation and research programme on the subject should be initiated.

The major reason for discarding is size rather than species. Discards of under-sized fish of commercial fish species have a particularly negative impact on the resources. There is no system in Bangladesh to assess the discard amounts.

Non-commercial, non-edible, species have obviously little access to markets and are therefore wasted most of the time.

Years of experience from similar fisheries around the world has clearly demonstrated that the production of certain fish products, such as frozen minces are not perceived as fish by the prospective consumer

When the net is hauled and the catch spills on the deck, it is immediately sorted by the crews with priorities in mind. Recovery of the shrimp is the first consideration; second is the selection of large high value fish. During every part of the voyage, it is most likely that all other components of the catch will be thrown back to sea. This includes genuine trash, which cannot be utilized (for example seaweed, molluscs, non-penaeid crustaceans and small inedible fishes) and also smaller (but often larger than 15 cm) low value species of fish, like croakers (*Sciaenbidae*), cat fish and jack fish (*Carangidae*). Only toward the end of a voyage, when the available storage space is easier to predict, attempts are made to retain the miscellaneous by-catch. The BOBP and NRI studies on shrimp by-catch during 1990-91 indicated that no solution has been found to utilize the by-catch.

**ii) Detrimental effect of shrimp trawling on the resources**

There are no currently published analysed data which prove that shrimp trawling in the Bay of Bengal has had a significant detrimental effect on the demersal finfish fishery. However, the composition of the catches is not exclusively small species but also many fish at first maturity. It follows that apart from the sheer waste of a protein resource, there exists the unproved possibility that the shrimp industry is adversely affecting stocks of finfish which could be harvested by other fishermen. The abundance and diversity of coastal fishery resources have supported vibrant small scale fisheries for centuries. A feature of these coastal fishery resources is that many species increase in size with depth. This highlights the significance of the near shore as nursery grounds for many shrimp and finfish and concentrated small and large scale fishing on these areas causes serious damage to the resources at the nursery stage. The abundance of many valuable shrimp in near-shore waters and the concentration of finfish in areas of less than 40 m depth has encouraged the incursion of trawlers on shallow grounds. Fishing in these shallow nursery areas has resulted in many juveniles being killed before they get the chance to mature and add substantially to production. The gear used by the small-scale fishery has no adverse effect on the bottom of the near shore areas, but there is serious damage to the bottom communities by shrimp trawling in these areas.

**iii) Reduction of recruitment due to killing of spawners**

The trawler fleet at present has no restriction on fishing activities in respect of seasons. They harvest all sizes of fish and shrimp, some of which could spawn if not caught, thereby hampering recruitment. The existing rules for the closed season to facilitate the breeding of shrimp and other species are not in force. The result is indiscriminate trawling throughout almost the whole year leading to depletion of the spawners.

**iv) Effect on benthic communities**

The shrimp trawlers are fishing with two to four trawl nets at a time. In this kind of trawling, heavy chains called trickler chains are attached to the bottom line of the mouth of the trawl net which is dragged over the sea bed to drive shrimp into the trawl nets, destroying other shellfish, worms, sea urchins and all other bottom dwelling creatures. The whole benthic habitat including nests of many benthic organisms are being destroyed by trawling activities. The whole shrimping ground of Bangladesh is criss-crossed by the shrimp trawlers. In comparison to a field being ploughed over and over again, the intensive dragging of trawls kills and prevents the benthic organisms to settle.

There are no extensive sea grass beds in the Bangladesh marine waters except a few patches of seaweed and some reefs which are also being destroyed by shrimp trawling.

The benthic organisms are supposedly the most essential part in the food chain of the oceanographic environment. From the estimate made so far on the destruction of benthic fauna and their habitats by the shrimp trawling activities, the situation is alarming. There is a continuous destruction of the benthic habitats and organisms by the shrimp trawl nets which will lead on shrimp fishing grounds to the extinction of most of the benthic fauna and ultimately break the food chain seriously affecting the marine ecosystem.

Trawling profoundly disturbs the sea bed, churns and resuspends sediments. A shrimp trawler with 4 nets, 15 m in width towing 5.55 km per hour (3 knots) scrapes about 1 $km^2$ of seabed in 3 hours. Trawling affects benthic communities both directly and indirectly. Direct effects include damage (and often death) of target and non-target species due to contact with the trawl nets and physical alteration of the seabed. Indirect effects include the resuspension of sediment particles, toxic chemicals, and nutrients, as well as discarding of by-catch, which affects food chains.

The sea floor is not covered by homogeneous, featureless, accumulations of sediments, but is sandy and muddy with a complex structure made up from non-living objects (rocks, shells, worm-tubes, etc.), living organisms (seaweeds, sponges, bryozoans, molluscs) and most of all, the results of biological activities such as burrowing.

Bottom trawling affects the benthos when churned-up sediments resettle. Suspended particles in the water increase an average of 1 000% shortly after trawling. In addition to burying benthic organisms, resuspended sediments can diminish photosynthesis in the water column inhibiting feeding and raising the metabolic rate of clearing sediment particles in suspension-feeding organisms. As a result, frequent resuspension can change the dominant species in the benthic community from suspension feeders to deposit-feeders (WRI, *et al*, 1922).

**Extent of damage on the benthic communities by the shrimp trawl net**

In Bangladesh at present there are 45 shrimp trawlers ranging in length from 20.5 to 44.5 m in operation. Out of the 45 trawlers, 32 use 2 trawl nets and 13 use 4 trawl nets during fishing operations. For trawlers using 2 nets the mouth opening of each net during operation ranges from 21 to 26 m (average 23.5) and for trawlers using 4 nets, the mouth opening of each net varies from 13 to 15 m (average 14 m). The surface of the sea bottom affected by the shrimp trawl nets is shown in Fig. 3.

Each of the shrimp trawlers using two nets operate 160-176 days (average (168) per year and 20-22 days (average 21) per month. Duration of each haul ranges from 3-3.5 hours (average 3.25). The four net users operate 220-250 days (average 235) per year and 22 to 25 days (average 23.5) per month. Duration of each haul ranges from 4 to 5 hours (average 4.5). Trawlers with two trawl nets operate 4.92 hauls per day, i.e. (168 x 4.92) = 826.56 hauls per year and (3.25 x 826.56) = 2 686.32 hours per year. Trawlers with four trawl nets operate 3.55 hauls per day, i.e. (235 x 3.55) = 834.25 hauls per year, i.e. (834.25 x 4.5 hours) = 3 754.13 hours per year.

**To calculate the sea bottom affected by shrimp trawling the following methods were used:**

Area covered per hour = width x speed of the trawler

**(Trawler using 2 trawl nets):**

Speed 3 nautical miles (5.55 km)
Head rope length or width of one trawl net = 23.5 m
Total width of 2 nets = 23.5 x 2 = 47 m $\frac{47}{1000}$ = 0.047 km
Therefore, the area covered per hour per trawler = 0.047 km x 5.55 km = 0.26 km

Area used for one haul per trawler using 2 nets = 3.25 hours x 0.26 $km^2$ = 0.845 $km^2$

Each trawler operates 4.92 hauls per day

in 168 days (per year) = (4.92 x 168) = 826.56 haul/trawler/year

Therefore 32 trawlers operate (32 x 826.56) = 26 449.92 hauls/year

**A.** Bottom area covered in one year by 32 shrimp trawlers operating two trawl nets at the same time:

26 449.92 hauls x 0.845 $km^2$ = 22 350.18 $km^2$

**(Trawlers using 4 trawl nets):**

Speed 3 nautical miles (5.55 km)

Head rope length or width of one trawl net = 14 m

Total width of 4 nets =14 m x 4 = 56 m $\frac{56}{1000}$ = 0.056 km
Therefore area covered per hour per trawler = 0.056 km x 5.55 km = 0.31 $km^2$

Area used for one haul per trawler using 4 nets = 4.5 hours x 0.31 $km^2$ = 1.40 $km^2$

Each trawler operates 3.55 hauls per day

In 235 days (per year) = (3.55 x 235) = 834.25 hauls/trawler/year

Therefore 13 trawlers operate (13 x 834.25) = 10 845.25 hauls/year

**B.** Bottom area covered in one year by 13 shrimp trawlers operating four trawlnets at the same time :

10 845.25 hauls x 1.40 $km^2$ = 15 183.35 $km^2$

**Total area covered by the nets of (32 + 13) = 45 shrimp trawlers in the continental shelf of Bangladesh is (22 350.18 $km^2$ + 15 183.35 $km^2$) = 37 533.53 $km^2$.**

From the above estimate it is seen that 45 shrimp trawlers operating in the marine waters of Bangladesh damage severely the benthic communities and the habitats of the benthos covering an area of about 37 533 $km^2$ at least (almost a quarter of the total EEZ) for 168 to 235 days in the year.

**v) Changes in species composition**

The increased intensity of exploitation of resources by trawling has induced achange in prey-predator relationships. Consequently, changes in catch composition have been observed. The high value demersal fish like red snappers, groupers and large croakers are declining. There is an increase in low value threadfin breams, red fish and small catfish and jewfish. The large demersal finfish have declined partly because these species are long living, implying slow replenishment, and partly because shrimp trawlers are catching large quantities of juveniles. Due to decline in some of the large predators of cuttle fish and squid egges being ignored by the trawl fishermen, a significant increase of these high export value species was observed in the catch.

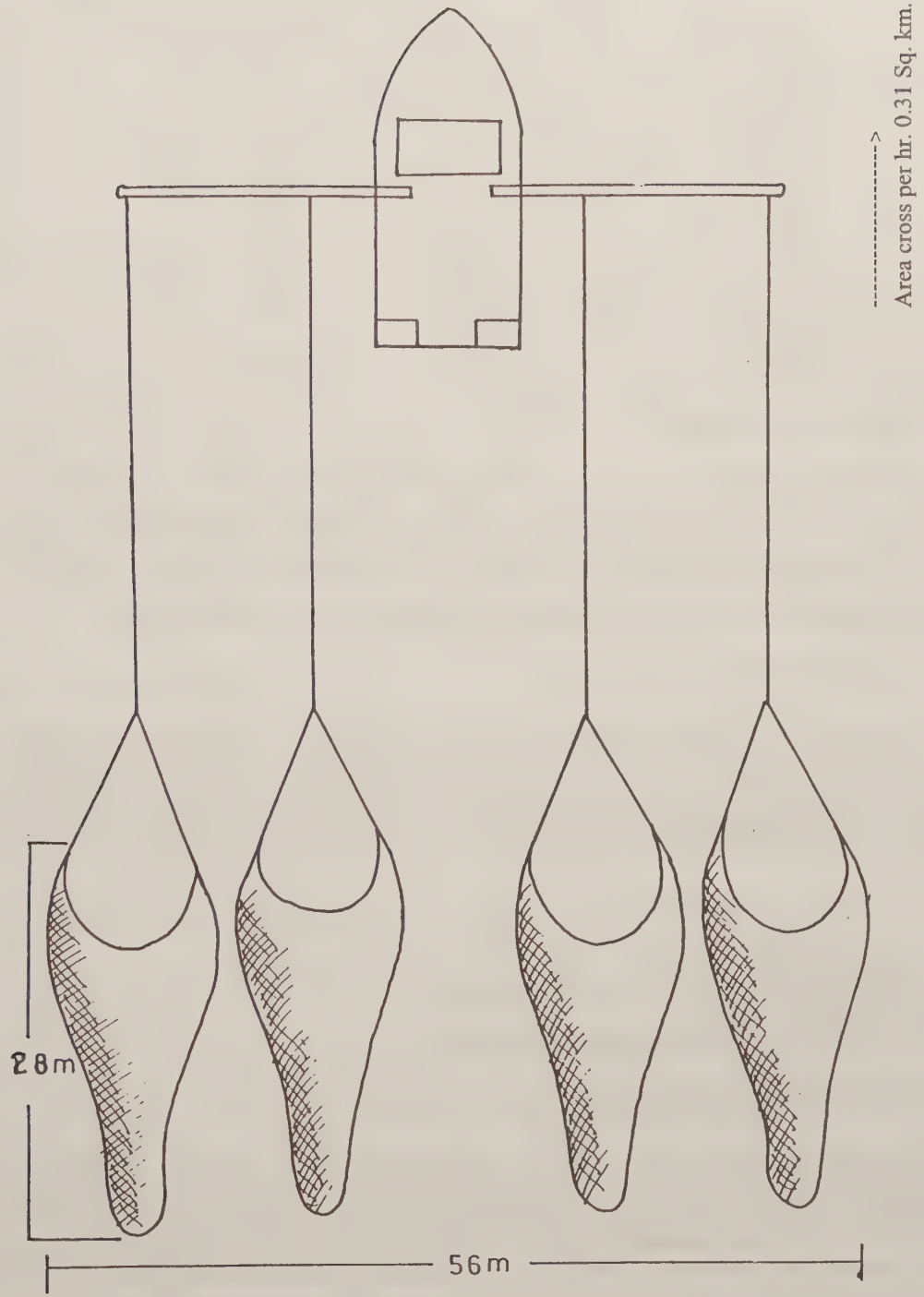



**Fig.3 Surface of the sea bottom affected by shrimp trawl nets.**

In general, the decline in the finfish and shrimp trawl catch rates has driven the trawlers towards the shallow water zones.

As an example, the change in the percentage composition was found evident by comparing the catch from a fish trawler ("F.V. MITALI") in 1991 and 1998 as given below:

| Name of fish | % in 1991 | % in 1998 |
|---|---|---|
| Pomfret | 2.28 | 1.06 |
| Jewfish | 18.48 | 11.61 |
| Snapper | 1.36 | 0.35 |
| Grunter | 1.76 | 0.63 |
| Catfish | 16.15 | 17.41 |
| Ribbon fish | 9.28 | 8.07 |
| Eel | 1.40 | 0.99 |
| Pama Croaker | 0.62 | 0.89 |
| Sea perch | 0.52 | 11.86 |
| Mixed | 3.59 | - |
| Others | 44.50 | 47.10 |

**vi) Depletion of resources**

The rapid expansion of shrimp trawling has resulted in catches with large quantities of small fish and juveniles of finfish which are regularly discarded each year. At the same time, introduction of large vessels with high efficiency for shrimp trawling has resulted in excessive fishing effort in the depths of 20-70 m, which has made the penaeid shrimp stocks as well as other finfish vulnerable to overfishing.

It is in general agreed that the Bay of Bengal requires significant reduction in fishing effort.

### 10.3 Impact of trawling on environment

The quality of the sea water from the chemical point of view and biological productivity are affectedby the degree of discards from the trawl net and different discharges from the trawlers. Almost all the trawlers discharge the shipborne pollutants directly into the sea. Besides, about 35 000 metric tonnes of trash fish are discarded directly from the trawlers. In a relatively small fishing area, this sort of discard poses a serious environmental hazard by:

- polluting the environment;
- increasing animals of prey (shark) in the fishing ground
- decreasing dissolve oxygen
- increasing **BOD** (Bio-chemical oxygen demand)
- increase of pathogens
- incremental situation of disease outbreak, etc.

### 10.4 Interaction on other fisheries due to by-catch discards

The shrimp trawl fishery discards the juveniles of commercially important fish and shellfish which results in growth overfishing. This prevents the maturing of juveniles of important fish and shellfish. In addition, this fishery hinders the recruitment of sciaenids to the bottom longling (BLL) fishery due to catching the juveniles and pre-adults of this group. The shrimp trawl fishery also discards the small adult fish and other true trash which pollute the water when it is decomposed and hence affects the fishing ground. The dead fish attracts sharks which chase the other fish and disturb the fishing ground. Hence tra vl fisheries are deprived of catching sufficient quantities of fish and shrimp. If the small adult fish were not caught and discarded by the shrimp trawlers these could also be exploited by the small-scale fisherfolk.

### 10.5 Impact of artisanal fishing activities on living aquatic resources

Artisanal fisheries include a number of different types of fishing gear and craft as described before. According to the recent survey reports about 55% of the artisanal production is contributed by the drift gillnetters (mainly composed of hilsa) and 30% is contributed by the estuarine set bagnet (most of the

catches being juveniles and post juveniles of marine fauna). Catch records for some of the fishing gear used for artisanal fishing are described below:

**i) Estuarine set bagnet fishery (ESBN)**

The penaeid shrimp are mostly caught by this gear within the size of 2-15 cm except *P. monodon* which rangesfrom 5 to 20 cm showing peak at the size of 8 cm. The predominant length of brown shrimp (*M. monoceros*) was 5-7 cm but some were smaller. Most of the species caught are juvenile or at the immature stage. It is mentioned here that tiger, white and brown shrimp are considered to be mature at the sizes of 18 cm, 12 cm and 10 cm respectively. The size range of most of the finfish which were caught below 20 cm having the predominant size ranging from 5 to 10 cm indicating that the gear ESBN was mainly catching juveniles.

From a year round study (BOBP 1993) it was found that most of the marine shrimp and fish species, such as *P. monodon, P. indicus, M. monoceros, M. brevicornis, M. spinulatus, P. sculptilis, H. nehereus, L. savala, S. domina*, are overfished. This may have been influenced by the predominant catch of very small sizes of marine fauna by ESBN on the other hand very poor catch of the large sizes. But the estuarine species such as *Acetes indicus* and *Setipinna taty* are underfished, although some of the estuarine (non-marine) species are either over-exploited or fished at the optimum level, *Palaemon styliferus, M. rosenbergii, S. sihama, S. tri, E. tetradactylum* and *P. paradiseus*. The estuarine set bagnets are therefore considered to be destructive since it catches juveniles of a large variety of shrimp and finfish species of commercial value.

**ii) Marine set bagnet (MSBN)**

The species caught by this net is similar to that of the catches of ESBN excepting the catch at the pre-adult and adult stages. There is not sufficient indication of overfishing with the use of marine set bagnets.

**iii) Beach seine (BS)**

The beach seine also catches the juveniles of jewfish, anchovies, clupeids and small shrimp. It was observed from a year-round study (BOBP 1993) that most of the fish and shrimp species usually caught by this net are juveniles or fish at immature stages. During fishing large size turtle are also caught and left dead on the beach. By this gear a large number of non-conventional animals are also caught and discarded. This gear is considered destructive for the resources.

**iv) Shrimp post larvae fishery (PN)**

The coastal aquaculture industry in Bangladesh for culture of penaeid shrimp has developed and is mostly dependent on the supply of wild seed. Harvesting of tiger shrimp along with the larvae and post larvae of almost all fish, other shrimp including catch of the early stages of other marine fauna, are increasing day by day. According to the recent survey report (BOBP 1993) more than two billion larvae of *Penaeus monodon* are caught by the seed collectors annually along the coastline. Exploitation of penaeid shrimp by different gear at different stages of the life cycle is shown in Fig. 4.

This two billion tiger shrimp larvae is only less than two percent of the total catch of the seed collected, the rest of which (more than 98%, i.e. other penaeid shrimp 11%, caridean prawn 13%, finfish larvae 12%, zooplankton including other organisms 62%) is just discarded dead which includes larvae of other shrimp, fish and zooplankton.

On the other hand out of the total number of *P. monodon* removed from the sea and estuary by different fisheries, the shrimp seed fishery alone takes 99.568%, while the ESBN and trawl fishery take 0.215% and 0.215% respectively. But when the percentage of harvest is calculated in terms of weight the impact is just the reverse, i.e. the trawl fishery takes 61.27% and the shrimp seed fishery takes only 3.08% while ESBN 35.65%.

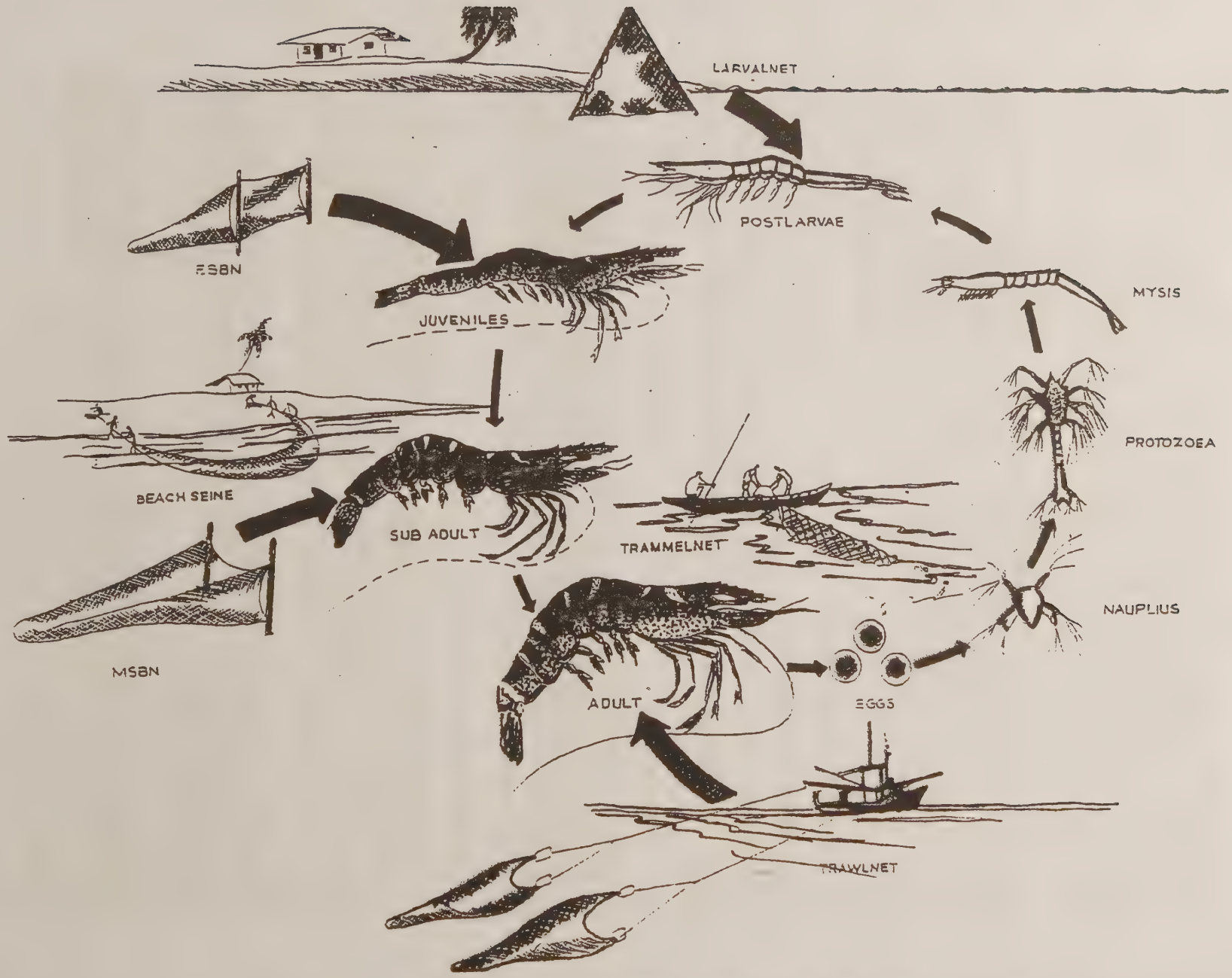



**Fig. 4 Exploration of Penaeid Shrimp by Different Gears at Different Stages of Life Cycle**

A considerable part of the two billion larvae of tiger shrimp (and also other fish and shrimp larvae) would have the chance to go back to sea to grow to adult size to make a substantial increase in the catch and catch rate of shrimp and fish by the offshore fishing gear, if not caught in the estuaries and along the coastline.

**v) Gillnet fishery (GN)**

The various species caught by drift gillnets (small and large mesh) are at the adult stages. There is therefore no damageto the resource. There is no evidence of damage from fixed gillnet, bottom set gillnet and mullet gillnet. However, fishing on hilsa spawner and jatka (juveniles of hilsa) in the riverine ecosystem affects the hilsa population of marine waters.

### 10.6 Impact of trawling on the national economy

Although the offshore trawling industry contributes to the national economy through export earnings, employment opportunities and industrial development, it sometimes also has an indirect detrimental effect on the economy by causing over-exploitation and environmental degradation. Over capitalization within the fishing industry leads to less return of revenues and the decrease of profits generates conflicts between fishermen competing for limited resources. In Bangladesh it is common for the offshore trawlers to exploit fishing areas of artisanal fisheries when there is a shortage of fish in their designated depths. This always creates social conflict between the trawlers and the artisanal fishermen.

It is evident that if the fishing industry continues to expand at the present rate more and more coastal fisherfolk will be driven to poverty level due to a loss of livelihood.

## 11. EXISTING RULES AND REGULATIONS FOR MANAGEMENT OF MARINE FISHERIES RESOURCES

The Government of Bangladesh promulgated the Marine Fisheries Ordinance for the management and conservation of marine fisheries resources. Under the provision of the Ordinance the Government framed the Marine Fisheries Rules. The Ordinance and the Rules are the main regulatory legal framework for the management of the marine fisheries resources of Bangladesh. For the management of the trawl fisheries the Government has limited the number of trawlers to 73 which are allowed to operate in the EEZ of Bangladesh. The number of shrimp trawlers has been limited based on the previous survey results. At present the Government has a proposal. based on advice from various experts, to reduce the number of the existing 45 shrimp trawlers which are to be replaced by fish trawlers. The reasons behind this is that it is already proved that the shrimp trawlers are responsible for the wastage of resources by discarding the by-catch and also for damaging the marine ecosystems. The present management measures under the Marine Fisheries Ordinance has a provision to protect the fisheries resources. Some of the important provisions in the Ordinance are as follows:

**i) Limiting the fishing days**

The shrimp trawlers are permitted to fish for 30 days and the catch for each trip must have a least 30% fish in the total catch. This measure was enforced in order to limit the discard of by-catch.

**ii) Facilitating escape of by-catch and small size fish and shrimp**

Mandatory 45 mm mesh size at the codend for the shrimp trawl nets is being enforced to facilitate the escape of small size fish, shrimp and the juveniles of larger fish. However, during the towing operation, the codend of nets are stretched and as such the mesh opening tends to become smaller restricting the escape of small fish. So the effectiveness of this system needs to be evaluated.

**iii) Depth zone restriction of 40 m**

There are provisions for restricting the shrimp and fish trawling within a 40 m depth zone. This measure at present is not in force due to a High Court injunction against it. This measure although initially designed to establish the rights of the artisanal fisherfolk is also to protect the nursery grounds

of marine fish and shrimp including the smaller groups of fish and shrimp in the area. The survey results indicate that about half of the marine fish stock lives within the 40 m depth zone.

### iv) Turtle excluder device (TED)

The use of the Turtle Excluder Device (Fig. 5) has been made mandatory to save turtles from being caught by the trawl nets. However, this order, again, is not in force due to a High Court injunction against it.

## 12. UTILIZATION AND EFFICIENCY OF TECHNICAL DEVICES BY THE TRAWL OPERATORS

Provision for the present management measures which were designed in order to reduce the amount of catch wasted by the shrimp trawl fisheries. The measures are to be implemented by the Marine Fisheries Office under the Department of Fisheries. The use of a prescribed mesh size is being ensured by random inspection of the trawlers before and after every fishing trip. Shrimp trawlers are not allowed to fish for more than 30 days and are encouraged to keep the bycatch on boardas far as possible. The mandatory provision of landing at least 30% fish of the total catch is also monitored. The Bangladesh Navy also takes part in regulating the trawlers activities.

The effectiveness of mesh size regulations in decreasing the amount of by-catch by the shrimp trawl nets in the tropical waters of the Bay of Bengal has not yet been studied. But from the assumption based on the studies in other parts of the world it was found that the mesh size regulation of the coded is not very effective in facilitating the escape of small or juvenile fish. Studies in this regard are essential to validate this assumption. Other measures such as the limitation of fishing to 30 days and the mandatory provision for landing certain quantities of fish, no doubt may help to bring some positive effects. These measures can be made more effective if, based on studies, the fishing days were further reduced. Preventing the shrimp trawlers from operating within the 40 m depth contour would help to bring down the quantity of by-catch discards as more than 50% of the fish stock, mainly the smaller groups of fish and shrimp, live within this depth zone.

The use of a Turtle Excluder Device (TED) to reduce catches of turtles is not popular with the trawler owners as they argue that it would also allow large size commercial fish to escape from the net. This is not totally unfounded as the design proposed for the TED has vertical bars, which would prevent the large size commercial fish from entering the codend. More studies on the effectiveness of BRDs and TEDs in reducing by-catch is necessary. The Government of Bangladesh made the use of the Turtle Excluder Device (TED) mandatory for shrimp trawlers to save the sea turtles. However, this is not in force as the trawler owners filed a petition in the High Court against it on the plea that this would result in catch reduction. The Court has put an injunction against this until further orders.

The by-catch reduction devices (BRD) used in other countries of the world have not been tested in Bangladesh yet. There are several designs of BRDs and experiments must be conducted to select the most effective ones for the tropical multi-species fisheries of the Bay of Bengal.

Modifying the codend of the net can facilitate the by-catch reduction. As the trawl net during the towing operation stretches longitudinally, the mesh opening in the codend tends to be smaller thereby reducing the escape of small fish. By using bridles or square shape mesh instead of diamond size mesh in the codend, the mesh remains open thereby facilitating the escapement of small fish.

As far as the economic aspect of by-catch utilization is concerned, it has so far not been very profitable for the shrimp trawl owners to bring the by-catch back to land. In a country like Bangladesh where there are widespread food prejudices, with the majority of the people taking a negative approach to seafood, it is very difficult to market sea fish. However, the consumption of sea fish is increasing day by day due to short supply of fresh water fish in the markets and the trawler owners are landing more and more species of fish/bycatch. Shrimp is still the targeted species and when there is a better shrimp catch, the by-catch is usually discarded.

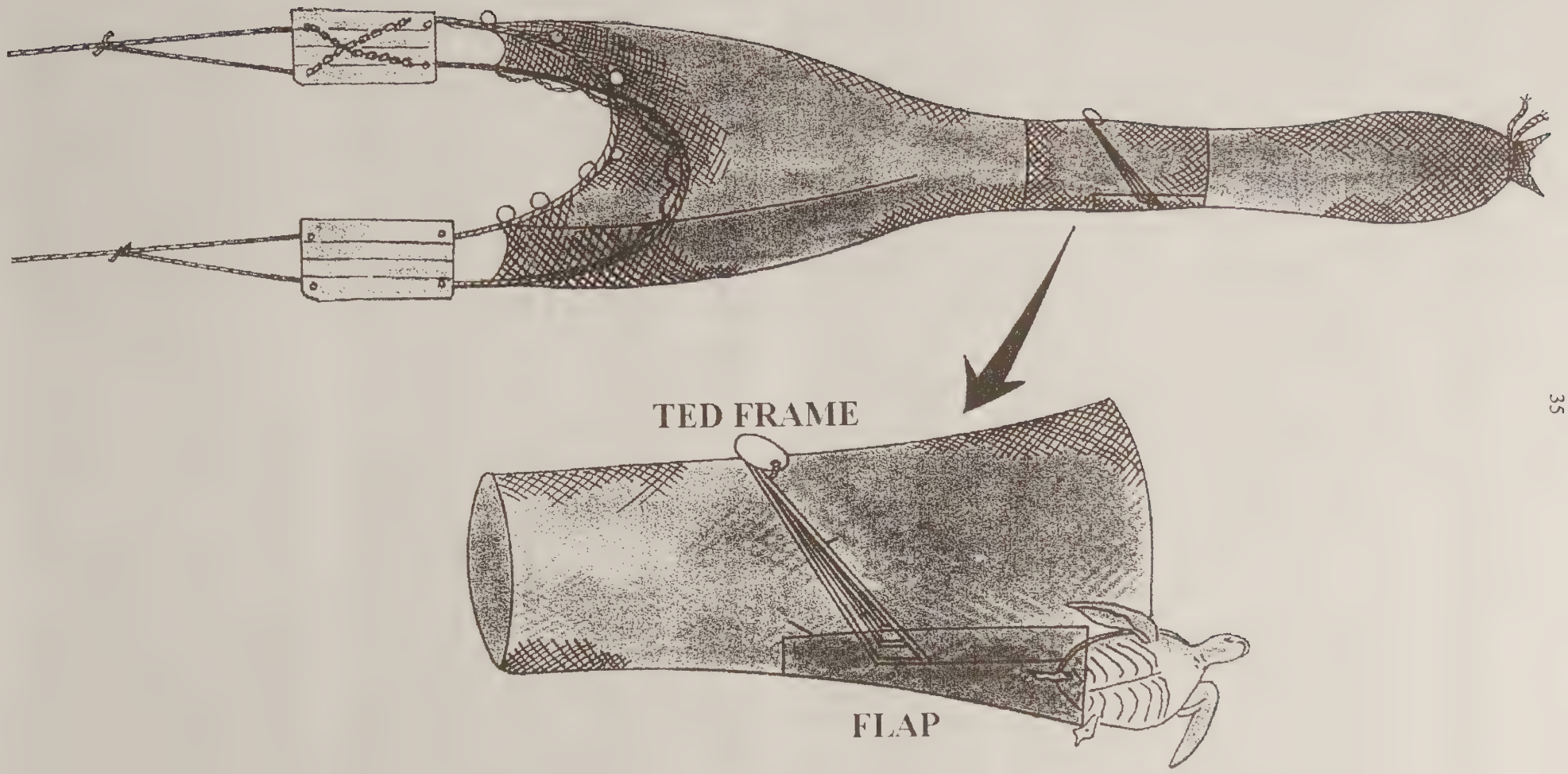



**Fig. 5 Turtle Excluder Device (TED)**

## 13. PERCEPTION OF SHRIMP TRAWLER OPERATORS ON ENVIRONMENTAL AND BY-CATCH ISSUES

The shrimp trawl operators are often very suspicious of the Government agencies and are of the opinion that the Government is imposing too many restrictions which are hampering their normal fishing operations. By this time several cases have been filed in the Court against some sections of the Marine Fisheries Ordinance. The restriction of shrimp trawling within 40 m depth zone, the closed season regime and the mandatory use of the turtle excluder device are under court injunctions. Communications with trawl operators and managers indicated that they do not perceive that shrimp trawling has a bad impact on the marine resources. The problem of low catches, according to them, is due to other destructive fisheries, such as shrimp seed collection and the estuarine set bag net fisheries which they feel are responsible for the destruction of the marine fisheries resources. They feel that the elimination of these harmful fisheries will help to increase bio-mass. There are also discussionsabout the quantity of by-catch which is discarded; the shrimp trawling operators claim that the known statistics regarding the quantities of by-catch discards are over-estimated. According to them the amount of discards has decreased in recent years as more and more fish species can now be marketed profitably: Non-conventional fish species are now being accepted by the people.

## 14. PERCEPTION OF THE OPERATORS OF THE TECHNOLOGICAL AND SOCIO-ECONOMIC CHANGES IN FISHING PRACTICES

The shrimp trawler operators seem to lack information about by-catch reduction devices (BRD) and many are of the opinion that introduction of any device would reduce their catch of shrimp and valuable commercial fish. The operators are not well aware of the use of square mesh and bridles at the codend to reduce by-catch. More effort is needed to inform the shrimp trawl owners and the operators on by-catch and its detrimental effect on the fisheries resources as well as on bio-diversity. The overall constraints preventing the widespread use of technologies designed to reduce by-catch in the shrimp trawl fisheries have to be further explored. Through limited communication with shrimp trawl owners and operators, it is clear that education and adviceon the use of by-catch reduction technologies are necessary.

## 15. TECHNICAL AND ECONOMICAL CONSTRAINTS FOR ADOPTION OF APPROPRIATE TRAWLING TECHNOLOGY

The trawler owners/operators are subject to various constraints. The constraints affecting perception and decision of the shrimp trawler owners/operators concerning the adoption of environmentally friendly techniques have not been fully analysed so far. The following assumptions have been made based on limited communication with industry people:

### i) Lack of trust in Government agencies

The shrimp trawl owners seldom trusts Government initiatives regarding management of marine fisheries resources and sustainable fishing. They feel that the Government agencies are pressing them with regulations which have not been tested effectively in conserving the resources or are not based on scientific facts or arguments. The common perception is that, in many cases, the Government arbitrarily imposes restrictions which stem from the bureaucratic culture of keeping the private parties under strict control, the measures will not help conservation of resources and the scientific basis for the decision is weak.

### ii) Ignorance about eco-friendly techniques

As already mentioned above the trawler owners/operators are, in general, not well aware of the different technologies being used worldwide to reduce the by-catch in shrimp trawling and there is often a firm belief that any devices being suggested will reduce the catch rate of shrimp and other commercial fish (while, in reality, there are devices which by reducing the by-catch prevent the target shrimp from being crushed by a large amount of it in the codend. When asked about the use of square mesh in the codend instead of diamond size mesh to keep the mesh open to facilitate the escape of small fish, the shrimp trawl operators seemed totally unaware of such an existing method. Similarly they were not even aware of the use of short selvage ropes along the codend. The design, effectiveness and potential benefit of using by-catch reduction devices (BRD) are not very clear to the

fisheries management authorities and shrimp trawler owners/operators. No standard device for use in the tropical waters of the Bay of Bengal has so far been demonstrated or tested.

**iii) Economic reasons**

The various devices used to reduce by-catch in the trawl fishery are anyway perceived by the trawl operators as potentially reducing the catch of some fish species that are of good economic value. The trawl owners do not want to lose these catches as they supplement their incomes. If the shrimp catch declines the trawl operators will face the risk of losing profits. The underutilized fishhold space and the rise in price of the non-traditional species will encourage them to bring in more and more species and small sizes of different species which were discarded before. Awareness building to motivate the trawl operators towards the beneficial effect of conservation of resources is essential.

**iv) Social reasons**

Due to socio-religious reasons many species of marine origin are not eaten by the people of Bangladesh; while being treated as trash in the country, some of these species have a potentially very high value on the international markets.

## 16. ONGOING AND PLANNED RESEARCH AND STUDIES FOR PROPER MANAGEMENT OF MARINE FISHERIES RESOURCES

There has not been much research so far on shrimp fisheries in general and on shrimp trawling in particular. Valid scientific information in this regard is still lacking. No estimate of the type and amount of by-catch has ever been made so far. Likewise, there has not been any serious study on to what extent shrimp trawling is effecting the aquatic resources, bio-diversity and the ecologically sensitive environment. Research on different aspects of marine fisheries resources and also on resource utilization is needed. Only stock assessment programmes on a very limited scale havebeen madein the marine sector by the Department of Fisheries.

## 17. AVAILABILITY OF DATA AND INFORMATION, RESEARCH ACHIEVEMENTS AND NETWORKING CAPABILITIES

As already mentioned above, there is a lack of information. The data being collected from the commercial shrimp trawlers normally concern shrimp with commercial value only. There is nothing about other species of shrimp and fish including by-catch species. Information on the catches of shrimp from commercial shrimp trawlersare regularly reportedto assess the production of shrimp, trends of catch, etc. However, shrimp trawlers provide very little information on the fish catches which they land, although it is required by law that commercial trawlers keep detailed records of catch and provide the information to the Department of Fisheries. No attempt has ever been made to analyze and interpret the information collected so far to estimate the stocks of fish and shrimp. Very recently the cruise data for stock assessment performed by the Departmental research vessel in the EEZ of Bangladesh is being reported through a Regional Technical Assistance (RETA) project (ADB-RETA-5766) sponsored by ICLARM. Under the provision of the project the analyzed data will be disseminated through the internet to other countries associated with the project.

## 18. REQUIREMENT FOR STUDY AND RESEARCH AT THE NATIONAL AND REGIONAL LEVEL

There is definitely a serious need for more research on various aspects concerning shrimp fisheries, including fish/shrimp stocks, production trends, type and amount of by-catch, any detrimental effect on other fisheries, and , the socio-economical aspects.

From the review concerning the existing characteristics of shrimp harvest practices by different fisheries, it is clear that the present situation is very complex and shows a considerable threat to the coastal and marine aquatic living resources in terms of resource and conservation of bio-diversity. Moreover, the present fleet size of shrimp trawlers somehow depletes the standing stock while some over capitalization is leading to reduced economic benefits. It is very unfortunate that, until now, no precautionary approach or code of conduct has been applied to preserve coastal and marine habitats and the eco-system, to conserve the endangered species, to maintain generic and species bio-diversity of

indigenous resources and to assess the potential impact of gear and fishery which are very essential for designing a proper fishery management system. In this context, the following research proposals are suggested aiming toward sustainable shrimp fishery management and policy through participation of all stakeholders, institutions, policy makers, fishery communities, etc., including also study of the impact of trawling on the benthic fauna, the potential damages in order to find out the measures to prevent it:

- to study different types of BRDs in shrimp and fish trawl nets,
- to study advantages and disadvantages of using diamond mesh in the codend of shrimp/fish trawl nets,
- to study the stock and MSY of the pelagic fishery resources in the Bay of Bengal and recommend an appropriate method of exploitation,
- to study the stock and MSY of other resources such as lobster, squid and cuttle fish and to find an appropriate method of their exploitation and utilization,
- to study the stock and MSY of shrimp resources,
- to study the proper utilization of by-catch,
- to study the benthic fauna as well as damage caused by shrimp trawling with protection measures,
- to study the conservation and propagation of seaweed,
- to establish data base management system through computer networking for the industrial and artisanal sectors should be established,
- to conduct socio-economic studies on trawler fishery, and
- to evaluate extension and motivation programmes which should be undertaken for the industrial as well as artisanal stakeholders.

## 19. CONCLUSION

The people of Bangladesh prefer to eat freshwater fish rather than marine fish and this explains why so far so much attention has been paid to the inland fisheries. However, with the increase in population, the demand for fish is increasing. At the same time the fish production from freshwater sources has declined for many reasons.

Marine fisheries are gradually becoming more popular with the people of Bangladesh. The coastal fisheries of Bangladesh are considered to be very important as about 95% of the total catch from marine sources comes from artisanal fisheries. The 5% catch comes from the commercial shrimp and fish trawlers from the off-shore waters. Total production of shrimp would be 118 734 metric tonnes of which the shrimp taken by commercial shrimp trawlers is only 3 508 metric tonnes (head on). However, these trawlers severely damage the marine fisheries resources. In addition, the pollution from discarding chemical products, mainly oil from the merchant navy may seriously affect fish populations and marine fauna, in general. In addition, it is estimated that there are about 1 252 industrial plants settled in the coastal region of Bangladesh (chemical, food, medicine industries, other). These industries have increased in number and their effluents going out to sea also affect the living resources and marine habitats.

At present there is no effective mechanism through which collection of information and monitoring of activities of both the artisanal and commercial fisheries sectors can be done. Implementation of all the provisions in the existing marine fisheries ordinance and rules at field level is very inadequate. Very few studies have been carried out so far on stock assessment of commercial marine shrimp and fish; there is a lack of information on different parameters of oceanography and socio-economics condition of the fishery sector. All these elements would be essential for proper management of the resources and their exploitation. Related studies and research are necessary.

The marine section of the Department of Fisheries in Bangladesh seriously lacks manpower and facilities (As already mentioned, since independence almost all efforts and inputs in the fishery were dedicated to the freshwater sector). Considering these limitations, exchange of information and experience and intensive cooperation among countries of the world are essential.

## REFERENCES

**Ali, M.L., 1998**. The present status of Marine Fisheries of Bangladesh in context of its entry into the 21st century. Paper presented in the international seminar on Indian Ocean in the 21st century linkaghe and networking held Vigyan Bhaban, New Delhi, India, 9-10 February 1998.

**Bostock, B.B., 1991.** Shrimp By-catch, A problem in the Bay that has as yet found no viable solution. BOBP News, December 1991.

**BOBP, 1993.** Studies of interactive marine fisheries of Bangladesh, By of Bengal Programme, Madras, India, BOBP/WP/89:118 p.

**Engvall, L.O., 1990.** By-catch from shrimp trawling, Bay of Bengal News, Issue No. 39, September 1990.

**Khan, M.G. and M.A. Latif, 1985.** Potential constraints and strategies for conservation and management of open brackishwater and marine fishing resources. Paper presented at the National Seminar on Fisheries Resources Development and Management, organized by MOFL, Bangladesh with FAO and ODA, 29-30 November 19945 Dhaka, Bangladesh. 19 p.

**Khan, M.G., Alamgir, M. and M.N. Sada, 1997.** The coastal fisheries of Bangladesh P. 26-37'. In G.Silvestre and D. Pauly (eds) Status and management of coastal fisheries in Asia. ICLARM Conf. Proc. 53:208 p.

**Nuruzzaman, A.K.M., 1991.** Aquaculture in Bangladesh challenges and opportunities. Paper presented at the commonwealth senior fishery officials (CSFO) held in Rome 1991:13 p.

**Penn, J.W., 1983.** An assessment of potential yield from the offshore demersal fish stock and shrimp in Bangladesh waters (including comments on the trawl fishery 1981-1982). A report prepared for the Fishery Advisory Service (Phase-II) project, Rome, FAO. FE:DP/BGD/81. 634. Field document 44: 22 p.

**Rahman, M.M., 1997.** Precautionary approach to fisheries management, Bangladesh status paper. Paper presented at the Regional Workshop on the "Precautionary Approach to Fisheries Management" sponsored by BOBP/FAO, Madras, India 25-28 February 1997, 21 p.

**Saetre, R., 1981.** Survey on the marine fish resources of Bangladesh, Nov-Dec 1979 and May 1980. Report on surveys of the R.V. Dr. Fridtjof Nansen. Institute of Marine Research, Bergen, Norway:67 p.

**Sivasubramaniam, K., 1990.** Biological aspects of shrimp trawl by-catch. Bay of Bengal News, Issue No. 20, December 1990.

**Silvestre, G.T. and D. Pauly, Editors, 1997.** Status and management of tropical coastal fisheries in Asia, ICLARM Conf. Proc. 53:208 p.

**West, W.Q.B., 1973.** Fishery resources of the upper Bay of Bengal, Indian Ocean Programme FAO/UNDP/IOFC/DEV/73/28:42 p.

**White T.F. and M.G.Khan, 1985.** Marine Fisheries Resources Survey: Demersal Trawling Survey Cruise Report No. 1, FAO/BGD/80/025/CRI, Chittagong, 67 p.

**Vatten, F., Editor, 1994.** Coastal Development in the Bay of Bengal, SWEDMAR ISSN 110-5785:47 p.

**WRI, et. al., 1992.** Global Marine Biological Diversity, A strategy for building conservation into decision making. Island Press, Washington D.C., Cavelo, California, 383 p.

**INDONESIA**

**REDUCING THE IMPACT OF TROPICAL SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES THROUGH THE ADOPTION OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES IN THE ARAFURA SEA, INDONESIA**

by the National Committee for Reducing the Impact of Tropical Shrimp Trawling Fisheries in the Arafura Sea; Directorate General of Fisheries Department of ocean Exploration and Fisheries, Jakarta; Jl. Harsono Rm No.3; Tromol Pos No.: 1794/JKS; Jakarta. 12550, Indonesia; Fax. 7803196; E-mail: statikan@rad.net.id )

Abstract

In 1996, the trawl fishery in Arafura Sea caught around 20 000 t of shrimp (80% Penaeids, mainly banana shrimp *(P.indicus, P.merguiensis)* 35% of the total, tiger shrimp *(P. semisulcatus)* and endeavour *(Metapenaeus ensis))*. In addition, there are important shrimp fisheries outside the Arafura Sea (with trammel nets, gillnets, and bottom seines).

The shrimp/bycatch ratio ranges from 1:8 to 1:15. The vessels retain and land more and more edible fish for the domestic markets but the discard rates of small fish (juveniles) are still high.

The shrimp trawlers are supposed to use a Turtle Excluder Device (TED) or a Bycatch Reduction Device (BRD).

In 1999, 453 vessels were involved (small wooden vessels fishing with one trawl, larger steel vessels using two trawls with outriggers).

Fishing with a trawl for shrimp is only allowed in the Arafura Sea and beyond the 10 m isobath (and with a licence to fish).

The main problems reported include: weakness of monitoring and control of implementation of the regulations, lack of awareness of the existing fisheries regulations, increasing fishing effort and very high discard rates.

Resumen

En 1996, las capturas de camarón alcanzaron unas 20.000 toneladas métricas, producto de la pesquería de arrastre en el Mar de Arafura. El 80% de estas capturas fueron Penaeidos, principalmente camarón banana *(P. indicus, P. merguiensis*), mientras que el 35% del total estuvo constituido por camarón tigre ("tiger shrimp"*; P. semisulcatus*) y "endeavour" (*Metapenaeus ensis*). Adicionalmente, existen importantes pesquerías de camarón fuera del Mar Arafura en las cuales se emplean redes de trasmallo ("trammel nets"), redes agalleras/ de enmalle ("gillnets") y redes de fondo ("bottom seines").

La relación entre las capturas de camarón y la fauna de acompañamiento varía en un rango de 1:8 a 1:15. Las embarcaciones retienen y desembarcan cada vez más pescado comestible destinado el mercado doméstico, pero la tasa de descartes de pescado de tallas pequeñas (juveniles) continua siendo elevada.

Se supone que las embarcaciones de arrastre de camarón emplean dispositivos exclusores de tortugas (TED: Turtle Excluder Device) o dispositivos reductores de la fauna de acompañamiento (BRD: Bycatch Reduction Device).

En 1999, aparecen reseñadas 453 embarcaciones; básicamente, pequeñas embarcaciones de madera que pescan con una red de arrastre y grandes embarcaciones de acero, dedicadas al arrastre con tangones con dos redes.

La pesca de arrastre de camarón está permitida sólo en el Mar Arafura y más allá de la isóbata de 10 metros, siempre y cuando la embarcación posea licencia de pesca.

Los principales problemas reportados incluyen: debilidad en la vigilancia y el control de la implementación de las regulaciones, falta de conciencia en relación con las regulaciones pesqueras existentes, incremento del esfuerzo de pesca y tasas de descartes muy elevadas.

## PREFACE

The Arafura Sea is one of the most important fishing areas for demersal fisheries, especially shrimp in Indonesia. Administratively, the waters are situated between the Province of Moluccas (Southeast Moluccas District) and Irian Jaya (District of Sorong, Fakfak, Manokwari and Marauke). The long distance from the local community area allows only industrial scale fisheries to exploit the fish resources.

Exploitation of demersal/shrimp resources in the Arafura Sea started in 1969. As the selectivity of the shrimp trawl is low, different fish species and fish of various sizes are caught.

Shrimp (Penaeid) is the target species of shrimp trawls operating in the Arafura Sea. Other fish and organisms are considered as by-catch and the discarded catches are substantial.

In view of promoting responsible fisheries, the issue of biodiversity is of great concern to the international community and the impact of its exploitation has been assessed. In cooperation with FAO, and other countries carrying out tropical shrimp fishing, a study on the reduction of the impact of tropical shrimp trawling on resources, using environmentally friendly fishing gear, will be carried out. Indonesia, one of the participating countries, has appointed a National Coordinator to prepare a National Report.

For the preparation of the national Report, based on the Decree of the Directorate general of Fisheries No. 13660/Kpts/Tu.110/110/XII/99, dated 22 November 1999, a committee was established to assist the National Coordinator.

The National report was presented at the Asian Regional Workshop, held in March 2000 in Denpasar, Bali. At the workshop, discussions were held on the efforts to reduce by-catch of shrimp trawling and management of shrimp and demersal resources in the Arafura Sea.

This activity is expected to draw greater attention to responsible fishing in order to ensure sustainable marine resources which, in turn, will lead to shrimp fishing in the Indonesian waters being sustained.

Sugiri Elon
National Coordinator

## 1. INTRODUCTION

Fishing for shrimp using trawls in the Arafura Sea has been ongoing since 1969. Through cooperation on exploratory fishing between the Marine Fisheries Research Institute (Lembaga, Penelitian Perikanan Laut), Jakarta and a Japanese fishing company, the growth of fishery has been steadily increasing over the years, in actual fact from 9 to 453 units in 1999.

The shrimp trawl is the most productive fishing gear in the exploitation of demersal fish resources including shrimp. The target species is shrimp (penaeids), whereas other catches are considered as a by-catch product.

Under the Code of Conduct for Responsible Fisheries implementation, some countries and international organizations agree that in terms of utilisation of the marine resources, the development and use of selective fishing gear should be a priority.

In Indonesia trawling for shrimp is restricted: Presidential Decree No. 39 of 1980 bans trawls, however, Presidential Decree No. 85 of 1982 allows shrimp trawl operations from the shore, 130°E of East Indonesia if using Turtle Exclusion Device (TED) or Bycatch Excluder Device (BED).

Within the Project Development and Preparation Phase (PDF), GEF/FAO, a number of countries with by-catch problems have agreed to pay attention to reducing the impact of fishing on marine resources, the following being their main goals:

1) identification of fisheries where the by-catch or discard problem or habitat impacts are particularly severe.
2) identification of any barriers (technical, economical, human, etc.) which make change difficult.
3) identification of the potential roles of different stakeholders at the national level.
4) preparation of a main phase project.

In March 2000 a regional workshop was held in Denpasar, Bali. The following topics were considered:

1) collection of data and information network system.
2) setting up of close cooperation with fishing industries.
3) agreements on cooperation: proposals and conditions of execution.
4) setting up of a Nucleus Estate Smallholder (NES) scheme with shrimp trawl industries.

It was agreed that the main project would cover several activities such as:

1) testing and demonstrating By-catch Reduction Devices (BRDs) application in some fishing areas.
2) analysing (in detail) the impact of the shrimp trawl fisheries.
3) defining management measures (taking into account the development of efficient by-catch reduction devices and an assessment of the situation of living resources and their environmental factors).

## 2. THE STATUS OF SHRIMP FISHERIES IN THE ARAFURA SEA

### 2.1 Fishing Areas and Conditions

#### 2.1.1 Fishing Areas

Commercial trawling in the Arafura Sea began under a joint venture between Indonesia and Japan. Today companies under Domestic Capital Investment (PMDN) are also involved. Approximately 72 000 $km^2$ (Naamin 1984) of shrimp trawl areas have been intensively exploited.

1) **Kepala Burung** area (sub-areas I and II) covering Sele Straits, Bintuni Bay, Fakfak, Adi Island and Kaimana waters.
2) **Dolak and adjacent areas** (sub-area IV) which covers Kokonao waters, Aika, Mimika, Uta river mouth, Aidma and Digul.
3) **Aru and adjacent areas** (sub-area III) which covers eastern, southern and western parts of the Aru Islands (see Figure 1).

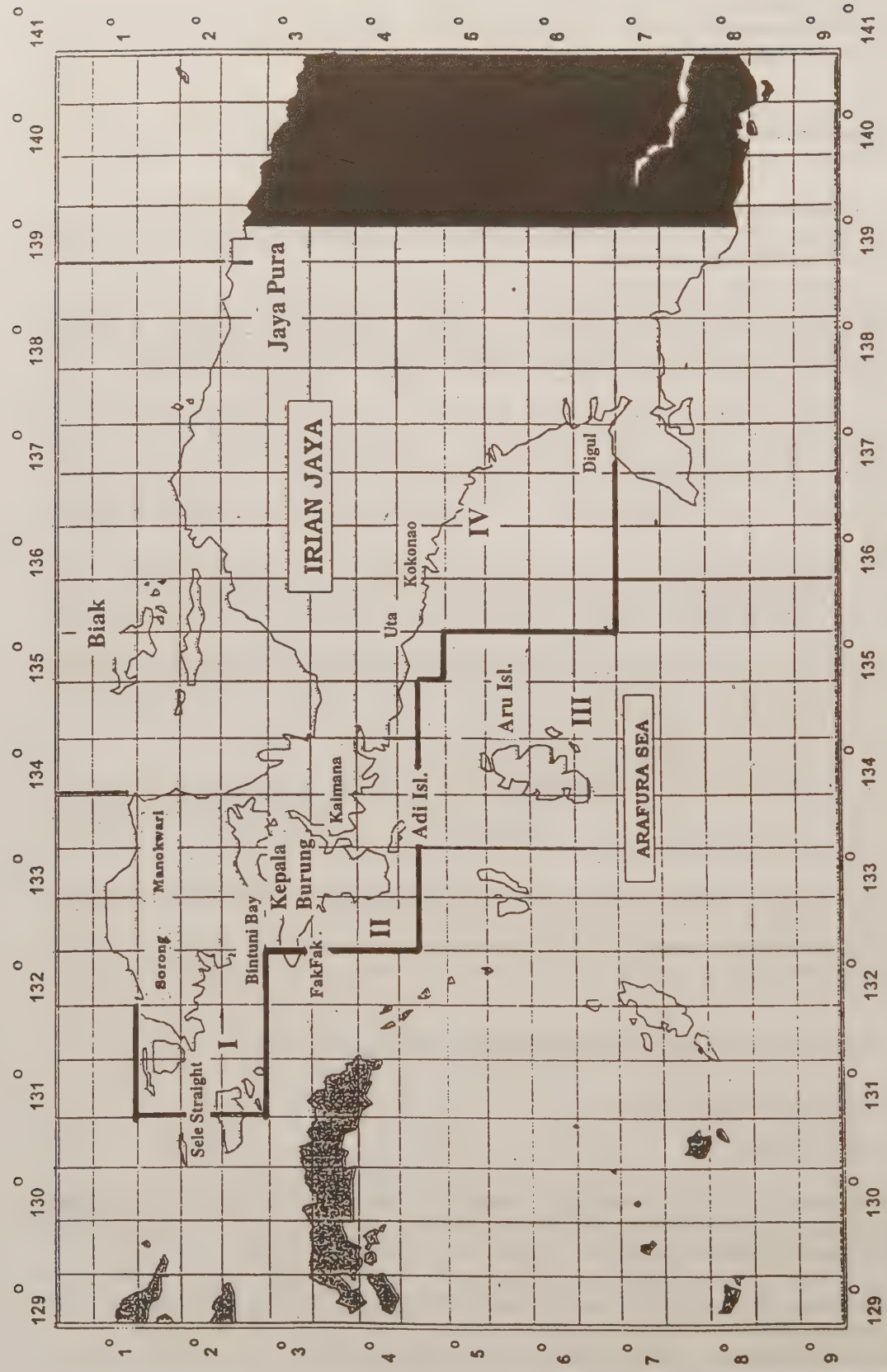



**Figure 1. Distribution of fishing ground of shrimp trawler in Arafura Sea of Indonesia**

### 2.1.2 Fishing Area Conditions

1) **Kepala Burung** cover approximately 15 000 km$^2$. Sea conditions are relatively calm and there are many small and large river mouths. The seabed is sandy and muddy and the colour of the water is almost grey. Dense mangrove growth is found along the coasts of Sele, Bintuni Bay and Kaimana.

2) Compared to other areas, **Dolak** is relatively wide, approximately 45 000 km$^2$ with dense mangroves along the coast and many river outlets. The condition of the seabed is generally muddy, sometimes muddy and sandy, and crabs and crustaceans are frequently found. The colour of the water is brown due to the strong river current. Shrimp is caught at a depth of between 5-50 m.

3) The total fishing ground of the **Aru and adjacent areas** is approximately 13 000 km$^2$. The seabed is slightly harder, consisting of a mixture of mud and sand, sometimes sand alone, and in certain areas crabs and crustaceans are found. In general, there are a lot of mangroves along the coast. Shrimp is mainly caught at a depth between 4-40 m.

## 2.2 Fishing Activity

### 2.2.1 Gear Used

Since 1969, when the shrimp fishery started commercially, the trawl has been the main gear used. There are three types of trawl used in the Arafura Sea, namely:

1) **Double rig shrimp trawl**: the headrope length is between 15 and 26 m. The mesh size of the codend is generally 11/14 inches (30 mm) and made of polyethylene (3 80D/72). A trynet, with a headrope length between 2 and 4 m is used.

2) **Single rig stern trawl**: headrope length between 26 and 35 m.

3) **"Quad trawl"**: this type has 4 codends. The headrope length is between 20 and 25 m.

According to Presidential Decree (Keppres) No. 085/1982 each unit should be equipped with a BED (By-catch Exclusion Device) which is a modified form of TED (Turtle Excluder Device).

### 2.2.2 Fleet Structures

Presently, there are 453 units trawling for shrimp in the Arafura Sea. The size varies from 19 to 849 GT.

**TABLE 1. Number of trawlers by size in GT**

| Size class (GT) | Units |
|---|---|
| 10-20 | 1 |
| 20-30 | 7 |
| 30-50 | 37 |
| 50-100 | 191 |
| 100-200 | 171 |
| >200 | 46 |
| TOTAL | 453 |

It should be pointed out that the predominant size of the trawler is 10-100 GT, followed by 100-200 GT. The smaller vessels (<100 GT) are mostly wooden vessels. The overall length varies from 20 to 45 m (see Table 2).

**TABLE 2. Number of Trawlers, by size, in length**

| Metres | Units |
|---|---|
| 20-25 | 167 |
| 25-30 | 168 |
| 30-35 | 63 |
| 35-40 | 30 |
| 40-45 | 25 |
| TOTAL | 453 |

The trawler's age varies from 7 to 40 years.

### 2.2.3 Shrimp Fishing Companies

The shrimp fishing companies operating in the Arafura Sea can be categorised into four groups:

1) Joint venture (overseas, PMA and PMDN).
2) National company, non PMA/PMDN.
3) Cooperatives.
4) State company (BUMN).

**TABLE 3. Number of Trawlers by company group**

| Company Group | Units |
|---|---|
| Joint Venture | 86 |
| National company | 361 |
| State company | 1 |
| Cooperatives | 5 |
| TOTAL | 453 |

### 2.2.4 Fishing Operations

In general, the duration of fishing trips vary from 40 to 60 days and the average total days at sea are approximately 280 days per year. There are approximately 7-9 hauls a day.

## 2.3 Fishing Effort

In 1999, there were 453 shrimp trawlers in operation. In general, the 50 GT trawlers, or smaller, are stern trawlers, whilst the larger ones are outrigger trawlers. Haul duration is between 2 and 3 hours, with towing speeds varying from 2 to 3 knots.

Catch data (1990-1998) collected by HPPI (Association of Shrimp Trawl Companies), gives the catch per unit of effort (kg/hauling), average number of hauls per day and average operational days per vessel as presented in Table 4.

The total catch and effort is calculated based on the Arafura trawlers catch data, which is recorded by HPPI.

The change in fishing effort from 1990 to 1998 is given in Table 4. Overall calculations of fishing effort in the Arafura sea in 1999 were estimated to be 86,640 operational days or 632,472 hauls. It can be seen that even though the amount of effort has increased, the catch per unit of effort (kg/haul) remains stable.

**TABLE 4. Calculation of fishing effort of shrimp trawlers in the Arafura Sea**

| Z | Year | Vessel (unit) | Days at sea | | Number of hauling | | Catch | |
|---|---|---|---|---|---|---|---|---|
| | | | Average | Total | Per day | Total | CPUE (kg/Hauling) | Total (Tones) |
| 1 | 1990 | 285 | 304 | 86,640 | 7,3 | 632,472 | 33 | 20,872 |
| 2 | 1991 | 390 | 302 | 117,780 | 7,5 | 883,350 | 37 | 32,684 |
| 3 | 1992 | 439 | 266 | 116,774 | 8 | 934,192 | 31 | 28,960 |
| 4 | 1993 | 359 | 264 | 94,776 | 8,2 | 777,163 | 25 | 19,429 |
| 5 | 1994 | 343 | 279 | 95,697 | 8,9 | 851,170 | 28 | 23,848 |
| 6 | 1995 | 374 | 275 | 102,850 | 7,6 | 781,660 | 34 | 26,576 |
| 7 | 1996 | 431 | 274 | 118,094 | 8,2 | 968,371 | 31 | 30,015 |
| 8 | 1997 | 431 | 271 | 116,801 | 8,2 | 957,768 | 34 | 32,564 |
| 9 | 1998 | 453 | 257 | 116,421 | 8,4 | 977,936 | 30 | 29,338 |

## 2.4 Catches

### 2.4.1 Catch Composition

Catch composition consists of Penaeids species as the target species and demersal fish as well as other (non fish and non shrimp) as a by-catch. The main species caught are given in Table 5.

**TABLE 5. The main species caught by shrimp trawlers in the Arafura Sea**

| Family | Species | Indonesia name | English name |
|---|---|---|---|
| Demersal fish | | | |
| Leiognathidae | L. bindus<br>L. equulus<br>Gazza minuta | Petek, peperck | Pony fishes |
| Sciaenidae | Johnius sp<br>Ototithes ruber | Tigawaja, gulamah | Croakers, jewfishes |
| Ariidac | Arius thalasinus<br>Arius maculatus<br>Arius cealatus | Manyung | Cat fishes |
| Dasyatididae | Dasyatis kuhlii<br>Himantura uarnak<br>Hypolophus sephen<br>Rhinoptera javanica | Pari | Stingrays |
| Gerreidae | Gerres abbreviatus<br>Gerres acianes<br>Gerres filamentosus | Kapas-kapas | Silver biddies |
| Lutjanidae | Lutjanus bohar<br>Lutjanus erythropterus<br>Lutjanus Johni<br>Lutjanus malabaricus | Barnbangan, kakap | Snappers |
| Mullidae | Upenerus sulphunerus<br>U. bensasi<br>U- tragula | Kuniran, biji nangka | Goat fishes |
| Nemipteridae | Nemipterus hexodon<br>Nemipterus japonicus<br>Nemipterus peroni | Kurisi | Threadfin breams |
| Polynemidae | Polynemus plebeius<br>P. sextarius | Kuro | Threadfin |
| Pomadasydae | Pomadasys kaakan<br>P. maculatus<br>P. multimaculatus | Gerot-gerot | Grunt sweetlips |

| Family | Species | Indonesia name | English name |
|---|---|---|---|
| Synodontidae | Saurida tumbil | Beloso | Lizard fishes |
| | S. undosquamus | | |
| | S. micropterus | | |
| Teraponidae | Terapon threraps | Kerong-kerong | Grunters |
| | Terapon jarboa. | | |
| Trichiuridae | Trichiurus savala | Layur | Hairtails |
| | T. lepturus | | |
| Penacidae | Penaeus monodon | Udang windu | Black tiger |
| | P. semisulcatus | Tiger | Flower tiger |
| | P. merguiensis | Udang putih | Banana |
| | P. latisulkatus | Udang raja | King shrimp |
| | Metapenaeus spp. | Udang dogol | Endeavour |
| | Parapenaeopsis spp. | Udang krosok | Rainbow shrimp |

**TABLE 6. Catch composition and catch rate of double rig shrimp trawler *Bawal Putih II* in the Arafura Sea**

| No. | Area | 1990 | 1991 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|
| 1 | Bintuni | | | | | | |
| | - Fish (%) | 74.4 | 79.0 | | | | |
| | - Shrimp (%) | 23.6 | 200 | | | | |
| | - Other (%) | 2.0 | 1.0 | | | | |
| | - C/Ft (kg/haul) | 85 | 214 | | | | |
| 2 | Dolak | | | | | | |
| | - Fish (%) | 84.0 | 85.0 | 94.5 | 86.0 | 94-3 | 86.2 |
| | - Shrimp (%) | 12,5 | 7.4 | 4.6 | 11.5 | 3.8 | 11.1 |
| | - Other (%) | 3.5 | 7.6 | 0.9 | 2.5 | 1.9 | 2.7 |
| | - C/Ft (kg/haul) | 237 | 246 | 547 | 300 | 990 | 359 |
| 3 | Kaimana | | | | | | |
| | - Fish (%) | | 76.8 | | 85.7 | 85.7 | 82.9 |
| | - Shrimp (%) | | 16.1 | | 11.4 | 11.4 | 11.8 |
| | - Other (%) | | 7.1 | | 2.9 | 2.9 | 5.3 |
| | - C/Ft (kg/haul) | | 246 | | 2.5 | 2.5 | 229 |
| 4 | Aru Island | | | | | | |
| | - Fish (%) | 84.1 | 89.6 | 81.3 | 85.0 | 85.0 | 83.2 |
| | - Shrimp (%) | 8.9 | 9.0 | 14.3 | 9.0 | 9.0 | 8.0 |
| | - Other (%) | 7.0 | 1.4 | 4.4 | 6.0 | 6.0 | 8.8 |
| | - C/Ft (kg/haul) | 223 | 406 | 260 | 389 | 389 | 298 |
| 5 | Arafura Sea | | | | | | |
| | - Fish (%) | 84.0 | 85 | 87 | 89 | 89 | 84 |
| | - Shrimp (%) | 12.0 | 9 | 10 | 7 | 7 | 11 |
| | - Other (%) | 4.0 | 6 | 3 | 4 | 4 | 5 |
| | - C/Ft (kg/haul) | 276 | 510 | 258 | 408 | 408 | 341 |
| | - C/Fu Shrimp | 33 | 45 | 34 | 30 | 30 | 37 |

***C/ft : average of total catching production (kg/hauling)***
*C/fu : average of shrimp catching production (kg/hauling)*

**TABLE 7. Composition of demersal fish caught in the Arafura Sea by shrimp area, in 1990-1991**

| No | Species | Bintuni | Kaimana | Dolak | Aru | Sum |
|---|---|---|---|---|---|---|
| I | Demersal fish (kg) | | 28,310 | 249,889 | 73,948 | 353,955 |
| | 1 . Leiosnathidae | 1,808 | 5,479 | 12,299 | 10,895 | 28,864 |
| | 2. Mullidae | 191 | 912 | 4,139 | 7,935 | 12,991 |
| | 3. Nemipteridae | - | 393 | 7,311 | 4,421 | 12,1125 |
| | 4. Pomadasydae | 9 | 1,874 | 8,666 | 4,229 | 14,779 |
| | 5 Threponidae | 28 | 553 | 4,685 | 6,431 | 11,697 |
| | 6. Sciaenidae | 1,206 | 9,659 | 96,473 | 8,473 | 107,338 |
| | 7. Synodontidae | 189 | 716 | 21,596 | 2,226 | 24,727 |
| | 8. Lutjanidae | 23 | 101 | 737 | 744 | 1,605 |
| | 9. Harponidae | - | - | 10,129 | 473 | 10,602 |
| II | Pelagic fish (kg) | 1,387 | 12,614 | 94,674 | 32J67 | 140,842 |
| | Number of hauling | 32 | 205 | 884 | 340 | 1,461 |

Other groups of species such as bivalve, sea snake and other live organisms were rarely caught. Based on 450 hauls made by *RV. Bawal Putih II,* only seven turtles were accidentally caught.

The catch data of a 380 GT double rig shrimp trawler in the Arafura Sea, during 1990-1998, pointed out that the catch composition consisted of approximately fish 83-89%, shrimp 7-13%, and other organisms 3-6%.

In the Bintuni waters, the recorded fish catch was 74-79%, shrimp 20-24%, and other organisms 1-2%. In 1996 the fish and shrimp ratio was 95:4.

Catch composition of fish in the Dolak waters was between 84-95%, shrimp 4-13%, and other organisms 2-8%. This varies each year.

In Kaimana the recorded ratio was 77-86% of fish, 11-16% of shrimp, and 2-7% of other organisms.

While in the Aru and adjacent waters, the composition of the catch was 81-90% fish, 8-14% shrimp, and 1-9% other organisms.

### 2.4.2 Fish Composition

From 1,461 hauls, catch production of fish during 1990-1991 was on average: 242kg/haul, which consisted of 30% croackers and jew fish, 8% pony fish and 7% lizard fish. The composition of fish caught varies according to the fishing areas, as shown in Table 7.

In *Bintuni Bay*, from 32 hauls the average fish caught was 57 kg/haul; dominated by pony fish, croackers, jew fish and lizard fish.

In the *Kaimana waters*, from 205 hauls the average fish caught was 138kg/haul; dominated by 34% croackers, jew fish and 19% pony fish.

In the *Dolak waters*, from 884 hauls the average fish caught was 283 kg/haul; dominated by 39% croakers and jew fish, 5% pony fish and 9% lizard fish.

In the *Aru Island waters*, from 340 hauls the average fish caught was 217 kg/haul; dominated by 15% pony fish, 11% croackers, jew fish, goat fish and grunters, and 6% threadfin breams.

### 2.4.3 Shrimp Composition

Shrimp composition which has already been presented in Table 5, can be categorised into 5 groups as follows: tiger, banana, endeavour, rainbow and other shrimp.

The shrimp composition consisted of 19-35% tiger shrimp *Penaeus semisulcatus*, 29-43% banana shrimp *Penaeus indicus*; *Penacus merguiensis,* and 21-31% of endeavour shrimp. The catch compositions vary every year, depending on the fishing area (see Table 8).

In *Bintuni Bay* it was on average 30-37 kg/haul, consisting of 8% tiger, 56-69% banana and 17-20% endeavour.

In *Kaimana* the catch is on average 23-38 kg/haul, consisting of 16% tiger, 44% banana and 27% endeavour.

In *Dolak* the catch is on average 20-34 kg/haul, consisting of 15% black tiger, 51% banana, and 23% endeavour.

In *Aru Islands* waters the catch is on average 20-25 kg/haul, consisting of 52% black tiger, 4% banana, and 22% endeavour.

**TABLE 8. Shrimp caught by shrimp trawl of *PT. Bina Utama* by fishing ground during 1992-1996**

| No | Year | Arafura Sea | FishingGround | | | |
|---|---|---|---|---|---|---|
| | | Total | Bintuni | Keimana | Dolak | Aru |
| 1. | Shrimp Catch (Kg) | | | | | |
| | 1992 | ° | 141,243,0 | 29,948.0 | 47,898.0 | 432.0 |
| | 1993 | 297,926.0 | 57,483,0 | 14,802.0 | 143,276.0 | 79,406.0 |
| | 1994 | 106,879.0 | 16,845.0 | 14,703.0 | 48,152.0 | 81,788.0 |
| | 1995 | 340,115.0 | 106,488.0 | 27,040.0 | 140,007.0 | 26,358.0 |
| | 1996 | 208,262.0 | 38,614.0 | - | 59,756,0 | 109,818.0 |
| 2. | CPUE (Kg/Hauling) | | | | | |
| | 1992 | 26.4 | 36.3 | 27.3 | 20.1 | 20.2 |
| | 1993 | 27.9 | 29.6 | 23.2 | 34.4 | 25.4 |
| | 1994 | 30.4 | 36.7 | 37.7 | 31.7 | 22.9 |
| | 1995 | 29.3 | 34.8 | 37.4 | 33.9 | 25.4 |
| | 1996 | 22.5 | 35.2 | 26.8 | 27.5 | 19.6 |

### 2.4.4 Other Organisms Caught

Other organisms such as squid, lobster, bivalve, turtle, sea snake and crab were caught in different quantities according to the fishing ground.

From May to October 1991 *the RV Bawal Putih* II in Dolak, caught 3,637 kg (or 6.7 kg/hour) in 546 hauls. An average of only 1.9 kg/hour was caught in shallow waters, whilst beyond a 20m depth the average was 4.9 kg/hour.

215 successful hauls resulted in an average of 1,932 kg or 9kg/hour in the Aru Sea. In deeper waters (more than 20-40 meters in depth) it was 9.2 kg/hour, while in shallower waters, only 7.1. kg/hour.

In Kaimana and Minika waters, 277 successful hauls gave 937 kg or, on average, 3.4 kg/hour. Beyond a depth of 40m, catch per hour was 2.3 kg.

### 2.4.5 Production Trends of Sea Fisheries Resources

From 1990-1997, the fish production in the Arafura Sea, which includes Moluccas Province (Southeast Moluccas district) and Irian Jaya Province (Sorong, Fakfak, and Merauke districts) increased yearly from 66,324 tonnes to 199,314 tonnes, or, an average of 33% per year.

Production of demersal fish increased every year, from 14,525 tonnes to 86,326 tonnes, an average increase of 82% per year. The important commercial demersal fisheries resources were: snapper, pompfret, cat fish, and thread fin fish.

The ever increasing rate of pelagic fish was 24% per year, or, from 24,490 tonnes in 1990 to 59,934 tonnes in 1997. The important commercial pelagic fisheries resources were tuna, tongkol, skipjack, shark and others.

The crustacean production increased by approximately 10% per year, from, 11,018 tonnes in 1990 to 17,864 tonnes in 1997. The crustacean composition was dominated by penaeids shrimp of black tiger, banana, endeavour, and rainbow shrimp *Parapenaeopsis spp.*

Other crustacean compositions were swimming crab, mudcrab, and lobster in relatively small quantities.

Apart from the resources mentioned above, bivalve, squid, turtle, jelly-fish and sea cucumber were landed. Production increased yearly, from 904 tonnes in 1990 to 5,639 tonnes in 1997.

### 2.4.6 Landing of By-catch Fish

It has already been noted that the shrimp trawl catches consist of shrimp, fish and other organisms. Any species other than the target species (shrimp) are considered as by-catch, of which some of them are landed and the rest discarded.

Table 9 shows that, in comparison to shrimp, a relatively large quantity of fish and other organisms are caught by shrimp trawls. According to estimates, it varies from 20 to 39 kg/haul or 160 to 312 kg/day.

**TABLE 9. Estimate of by-catch landed by shrimp trawlers**

| Year | Average landed (kg/hauling) | Number of hauling (times) | Landing (Ton) |
|---|---|---|---|
| 1990 | 20 | 632,472 | 12,649 |
| 1991 | 22 | 883,350 | 19,434 |
| 1992 | 20 | 934,192 | 18,684 |
| 1993 | 22 | 777,163 | 17,098 |
| 1994 | 22 | 851,170 | 18,726 |
| 1995 | 35 | 781,660 | 27,358 |
| 1996 | 39 | 957,768 | 37,766 |
| 1997 | 34 | 977,936 | 32,564 |
| 1998 | 25 | 574,773 | 24,448 |

The composition of the by-catch of shrimp trawls landed in Ambon and Sorong is shown in Appendix 1.

### 2.4.7 Standing Stock and Potential Yield

The estimated swept area is:

A = 2/3 HR (Head rope length) x Vessel's speed in knot x 1852 (1 knot = 1852 m/hour) x 2 (2 trawls towed at the same time with the outrigger rigging)

The catchability factor is estimated at 0.5 (Shindo,1973), i.e. that only 50% of fish and shrimp available were actually caught. Therefore, the stock density (ton/km$^2$) is equal to:

$$\frac{\text{Catch average (kg/hauling)}}{\text{A x 0.5}}$$

Calculation is based on catch of KM, *Kurnia VII* a double rig shrimp trawler of 180 GT.

In table 10, the overall standing stock for the Arafura Sea was estimated by multiplying the stock density by an area where it was possible to trawl.

The potential yield (Py) is estimated by using the formula Py = X (Y+MBo) (Gulland, 1968) where X is a constant (0.5), Y is the shrimp production of the Arafura Sea (16,973 tonnes in 1997), M is the natural mortality (0.5) and Bo is shrimp biomass (tonnes). The results give an estimate of a total potential yield (Py) for penaeid shrimp in the Arafura Sea of 20,501 tonnes for a fishing effort of 89,663 days which is equal to 320 vessel units (for an average of 280 operational days per year).

**TABLE 10. Calculation of standing stock of shrimp resources in the Arafura sea**

| No | Fishing areas | Tiger | Banana | Endeavor | Other Shrimp | Total |
|---|---|---|---|---|---|---|
| 1 | Bintuni & Kaimana | | | | | |
| | C (kg/hauling) | 5 | 13 | 6 | 5.5 | 29.5 |
| | *p* i (kg / km2) | 98 | 256 | 118 | 108 | 580 |
| | Bo (ton) | 1,470 | 3,840 | 1,770 | 1,620 | 8,700 |
| 2 | Dolak | | | | | |
| | C (kg/hauling) | 2 | 18 | 11 | 6 | 37 |
| | *p* i (kg/km2) | 39 | 354 | 216 | 118 | 727 |
| | Bo (ton) | 1,755 | 15,930 | 9,720 | 5,130 | 32,715 |
| 3 | Aru | | | | | |
| | C (kg/hauling) | 9 | 1 | 6 | 10 | 26 |
| | *p* i (kg / km2) | 177 | 20 | 9,118 | 197 | 511 |
| | Bo (ton) | 2,301 | 260 | 1,534 | 2,561 | 6,643 |
| | Arafura sea | 5,526 | 20.,030 | 13,024 | 9,491 | 48,058 |

**Remarks:**

C is an average of shrimp catching production (kg/haul).
Pi is the shrimp stock density (kg/km$^2$).
Bo is shrimp biomass (tonnes).
The total potential yield (Py), 20,501 tonnes consists per fishing area in:

- for Bituni/Kaimana, 3,712 tonnes with an effort of 125,830 hauling which is equal to 15,728 days or 56 trawler units
- for Dolak, 13,955 tonnes with an effort of 377,162 hauling which is equal to 47,145 days or 168 trawler units
- for Aru, 2,834 tonnes with an effort of 109,000 hauling which is equal to 13,625 days or 49 trawler units.

Considering the shrimp production estimate in 1998, 29,338 tonnes, as presented in Table 4, it would seem that the shrimp exploitation rate in the Arafura sea has already reached its maximum.

Data analysis of catch and effort from 1969 to 1981 for overall important commercial penaeid shrimp species in the Arafura Sea, by using Schaeffer and Fox models, gave a MSY value range from 14,700 to 15,000 tonnes per year. The optimal effort is 39,000 days which is the equivalent of 138 trawler units with a 500 HP, or, 215 actual days in operation per vessel/year.

The MSY estimated value for *Penaeus merguiensis* (banana shrimp) which is the main species caught, is between 6,400-6,550 tonnes per year with optimal catch effort ranging from 22,300 to 27,700 days of standard vessel (Naamin, 1987).

Other estimates of potential yield (1969—1990 data) when using the same models show that the MSY value was 10,350 tonnes per year; optimal catch per unit of effort was 33,676 vessel days. It would seem that the exploitation rate was again, nearly, completely exploited (DGF, 1995).

By using different data catch, i.e. 1982-1987 (Naamin, 1992) or 1985-1990 (Iskandar *et al*, 1993), the estimated value of MSY was 13,800 tonnes or 8600 tonnes respectively. The final result revealed that the exploitation rate for each period had nearly reached the fully exploitable level.

## 3. SHRIMP TRAWLING MANAGEMENT ASPECT

### 3.1 Fisheries Resources Management Policy

The fisheries resources management was established under Law No. 9 of 1985 on Fisheries. It states that fisheries resources management refers to all the measures taken to sustain and utilise the fisheries resources in an optimal manner. It includes measures for controlling fishing efforts to a level sustainable for fisheries resources, fishing practices acceptable for environments and assessment of other activities which impact fisheries resources and its environments.

Furthermore, Law No. 9 of 1985, para 4. includes management principles to be implemented under the Ministry of Agriculture; responsibilities which concern the following:

(1) regulation of the size of fishing gear.
(2) regulation of characteristics for fishing vessels and technical requirements for navigation safety.
(3) estimation of Total Allowable Catch (TAC) per species.
(4) establishment of Fishing Zonation (to protect small-scale fisheries) and fishing season/closed season.
(5) protect fisheries resources and environment from pollution and other damage; conduct rehabilitation and conservation of fish and its environment.
(6) introduction of species (to enrich fisheries potential).
(7) other related issues needed for fisheries management (for example controlling fisheries resources, participation of community, etc.).

The regulation of fisheries resources management consists into 8 categories of measures as follows: 1) regulation for mesh size; 2) regulation for TAC and minimal size of fish to be caught; 3) closed and open fishing season: 4) closed and open fishing in certain areas; 5) regulation for fishing gear and other related gear (for example: Fish Aggregating Device/"rumpon" type; 6) rehabilitation and conservation of fisheries resource; 7) regulation for issues related to species, conservation and fishing area approach; 8) regulation for relevant technology in terms of conservation of all species in a certain area or in general.

Each of the above regulations will be used for fisheries resources management in the Arafura Sea, especially in terms of controlled operations of shirmp trawls.

### 3.2 Implementation of Shrimp Trawl Management

#### 3.2.1 Trawl Banned and Shrimp Trawl Operation

Before Law No. 9 of 1985 on Fisheries, Government Regulation (PP) No. 15 of 1990 on Fisheries Business and Ministry of Agriculture Decree No. 815 of 1990 on The Authority of Fisheries Business License in the certain scale is a responsibility of the Local Government (Provincial Fisheries Service), that refers to Government Regulation No. 64 of 1957. Licences for fishing vessels used by foreign companies are issued by the Directorate General of Fisheries.

If capital investment is available, the licence is authorised by the Capital Investment Coordinating Agency/BKPM.

Regarding trawling by national companieslicences are issued by the local government, within the limits established by the regulations in Indonesia.. For the Arafura sea, licences for trawling are issued by both the Directorate General of Fisheries and CICA/BKPM (for fisheries businesses that have a facility of capital investment of Foreign Capital Investment/PMA and Domestic Capital Investment/PMDN).

With regard to the development of fisheries, the use of trawlers is controlled in order to maintain the fisheries resources sustainability and to prevent social conflicts among fisheries, mainly in the coastal areas where there is heavy fishing pressure by fishing vessels of different sizes. In light of this, fishing zonation for fishing vessels has been established to avoid resources being damaged and conflicts arising among the fishermen. Ministry of Agriculture Decree No. 607, of 1976, regulates the zonation. To protect small-scale fisheries from large-scale operations in their fishing grounds, the fishing grounds are divided into several zones to be utilised respectively by certain sizes of fishing vessels. Based on the decree, four areas/fishing zones are identified, as follows:

a) Fishing Zone I excluding:

- inboard fishing vessels > 5 GT or inboard fishing vessels > 10 HP.
- all trawl (beam trawl, otter trawl and pair/bull trawl).
- encircling gillnet and drift gillnet.

b) Fishing Zone II excluding:

- inboard fishing vessels > 25 GT or inboard fishing vessels > 50HP
- otter board length > 12 meters
- mid water trawl or pelagic trawl and pair trawl

c) Fishing Zone III excluding:

- inboard fishing vessel > 100 GT or inboard fishing vessel> 200 HP
- otter board length > 20 meters
- pair trawl.

d) Fishing Zone IV.

Trawl is the most effective fishing gear used to catch demersal fish, but also the cause of conflict of interests with the small-scale fisheries sector which has simple fishing gear, most of them set, passive, gear which are caught in the trawls.

The zone problem, especially in the Arafura Sea is not regulated by Ministry of Agriculture Decree No. 607 of 1976, however, there is another regulation which requires shrimp fishing to be undertaken beyond the isobath line 10 meters (Presidential Decree No. 85 of 1982 refers). This regulation in the Arafura Sea, does not limit the development of uncontrolled trawling. Therefore, under Presidential Decree No. 39 of 1980, the government decided a ban on trawling, the implementation of which is being done step by step.

The Ministry of Agriculture Decree No. 503/Kpts/Um of 1980 on Steps for Implementation of Banned Trawls Phase I includes a description of the trawl models which are banned. A Joint Cooperation Decrees (SKB) issued by three ministries, Home Affairs, Trade and Cooperation and Agriculture (No. 596/Kpts/Um/8 of 1980, No. 183 of 1980, No. 345/Kpb/VIII of 1980) includes guidelines for the Transfer of Fishing Vessel Free Trawl. Other Decrees of the Ministry of Agriculture regulate fishing activities such as Ministerial Decree No. 694/Kpts/Um/9 of 1980 which concerns b"Boundaries of Fishing Ground Area for Fisheries Business using Trawl" and Ministry of Agriculture Decree No. 542/Kpts/Um/6 of 1981 limiting the number of trawlers in the Province outside Java, Bali and Sumatera respectively.

The last phase was to ban trawling in all Indonesian waters through Presidential Introduction No. 11 of 1982 on Implementation of Presidential Decree No. 39 of 1980 which states that the remaining trawls used from 1 January 1983 are now banned totally in all Indonesian waters.

However, since the total trawl ban was issued, the government still allows specific types of trawls such as shrimp trawl. Considering that - shrimp production is needed to generate foreign currency, - the technology exists to reduce by-catch from trawl, - there are still fishing grounds which has not been exploitedand - capital investment policy (both Foreign Capital Investment/PMA and Domestic Capital Investment/PMDN), shrimp trawling is still authorized in areas such as: Arafura waters, Kei, Tanimbar and Aru, beyond 130°BT East.

Regarding its implementation, the regulations concerning fishing zones and trawl specifications are subject to violation. Gillnets or surrounding nets are modified or fishing operations are adjusted to take advantage of existing trawl regulation. The utilisation of certain gear in coastal areas creates severe conflicts between fishermen.

Indeed, monitoring at sea is conducted by both Fisheries Officers and Law Officers (Indonesian navy/TNI AL and Marine Police). However, because of the lack of means, financial and human resources, violations are frequent.

### 3.2.2 Controlling of Shrimp Trawl Net

As previously mentioned, the fisheries resources management has regulations. The implementation is, generally, as follows:

(1) Fisheries Resources Allocation

"Fisheries Resources Allocation" basically concerns the fishing effort being authorized in given areas, including for shrimp trawling. It is issued by means of Ministry of Agriculture Decree No. 995/Kpts/IK.120/9 of 1999. This Decree estimates the TAC for shrimp to 17,200 tonnes (while for demersal fishes, a total of 197,400 tonnes). Therefore, if the average CPUE for shrimp trawl net is around 10 ton/year (with fishing vessels 150-200 GT) then the number of shrimp trawl net to be operated in the Arafura Sea would be 156. Considering that the number of shrimp trawl net operated in the Arafura Sea is now 453 for a production amounting to approximately 49,830 tonnes, the conclusion is that shrimp is being over-fished in the Arafura Sea.

(2) Mesh Size Regulation

The regulation concerning mesh size is found in the Ministry of Agriculture Decree No. 392/Kpts/IK.120/4 of 1999: the minimal mesh size requirement is usually 25 mm (1 inch). This also applies to shrimp trawl net.

(3) By-catch Excluder Device (BED)

A pre-requisite of shrimp trawl net operation is the use of fish selective gear. The goal is to select fish in certain sizes. A BED can be installed between the body and the codend (Certains dimensions of the BED are adjusted to match the size of the trawl net). Shrimp fishing companies have the obligation to use BED in the Arafura Sea.

However, fishing companies report that BED is cumbersome and that it reduces the effectiveness of the trawl operation. Therefore, more research is required.

(4) Regulation for Fishing Zones

The regulations concerning the Fishing Zones aims to: 1) conservation of fisheries resources, especially in coastal areas, protection of nursery grounds, 2) protection of small-scale fisheries from competition with larger scale fisheries, 3) avoid conflicts among fishermen, in general.

The regulations concerning fishing zones is now found in the Ministry of Agriculture Decree No. 607/Kpts/Um/9 of 1976but it does not concern shrimp trawling operations since it does not apply to the Arafura Sea. In East Indonesia, only shrimp trawling is regulated with a use limited to beyond the 10 meters isobath line (Presidential Decree No. 85 of 1982).

The 10 meters isobath line limit is often not applied and shrimp trawlers often operate inshore where the depth is less than 10 meters in depth, even in estuaries. In these conditions, nursery grounds for shrimp/fish are affected and the sustainability of the resources is threatened.

(5) Pre-requisites for Fishing Vessels

The Ministry of Agriculture Decree No. 392 of 1999 regarding Fishing Zones authorizes Indonesian and Foreign Fishing Vessels to operate in the IEEZ area (except in Malaca Strait) using (whatever fishing gear is used) vessels not more than 350 GT. In accordance with the above, shrimp trawl net is authorized in the Arafura Sea only with trawlers less than 350 GT.

(6) Utilisation of Fish By-Catch

The fishery companies that have licenses to use shrimp trawl net have to hand over "fish by-catch" to the Fisheries/Cooperatives State owned Company/BUMN. Regulation on utilisation of fish by-catch is includedin the Presidential Decree No. 85 of 1982 and Ministry of Agriculture Decree No. 930/Kpts/UM/12 of 1982 and the Directorate General Fisheries Decree No. IK 010/S3.8063/82K, While the optimal fish by-catch utilisation is in line with responsible fisheries principles, the above mentioned requirement of keeping the by-catch on board is, practically, not easy to implement because of room limitation in the fish hold and time and effort which would have to be dedicate to handling this portion of the catch.

(7) Coordination of Fishing Management

Regarding proper preservation of resources and environment, sustainability of fisheries, with, if possible, some development the government has taken measures concerning fishing control and monitoring in Indonesia. The basis of this system is the delegation of authority given in this respect to regional governments, especially regarding fishing activities carried out by small fishing units, less than 30 GT and 90 HP.

The application for this management system is conducted through a Fisheries Resources Utilisation Coordination Forum (Forum Koordinasi Pengendalian dan Pemanfaatan Sumberdaya Ikan/FKPPS) which have annual meetings. The status of FKPPS is described in Ministry of Agriculture Decree No. 994/Kpts/Kp.150/9 dated 1999. Nine FKPPS have been established for the various areas of the countries. The Arafura Sea is included in FKPPS area VI.

The coordination forum discussed interests and related matters such as fishery regulation, in general, resources allocation, fisheries operation, both industrial and small-scale, fisheries monitoring and control, etc.

The above matters apply in particular to the Arafura Sea. However, it is worth reminding that regarding shrimp trawling, most of the relevant regulation is already under Presidential Decree No. 85 of 1982, including the limitation of the number of shrimp trawlers being authorized in the area (based on the issue of Fishing Permit (UP) for operation in the Arafura Sea).

## 4. RESEARCH ACTIVITIES

### 4.1 Results Obtained

As already mentioned, commercial shrimp fisheries in the Arafura waters, and its surrounding areas, began in mid 1969. The activities started with the operation of nine units of 100-300 GT. Since, the number of vessels increased rapidly, the equipment on board was modernized and the techniques improved.

Two periods can be distinguished for shrimp fishing development in the Arafura sea: before the introduction of By-catch Reduction Device (BRD) and after, from 1982.

The relevant research activities include those concerning shrimp resources (distribution, biology and population dynamic) and environment, fishing gears, socio-economic and by-catch utilisation.

#### 4.1.1 Research on living resources

The research activities in the field consist in species identification, species composition, stock assessment, shrimp resource distribution (fishing grounds and seasons), shrimp population parameters and biology. Both, research vessels and commercial fishing units are used.

Information collected in Arafura waters, amongst others, includes:

(1) shrimp species caught, in general
(2) species and size composition of shrimp caught according to the fishing ground
(3) distribution of effort and catch per species according to water depth and condition of seabed
(4) population parameter
(5) reproduction parameters (e.g. spawning season, recruitment pattern)
(6) stock assessment, sustainable yield and level of exploitation

After the introduction of regulations concerning by-catch reduction devices, in 1982, research related to by-catch was developed. It included, differences in compositions of trawl catch with and without BRD, ratio of shrimp and fish catch when using BRD, by-catch species composition with and without BRD, ratio of utilised and discarded by-catch (Sadhotomo, B.; Sumiono, B., 1986; Badrudin and Karyana, 1993; Naamin. N., Sumiono, B., 1993; Widodo, J., 1991; Nasution, Ch. 1995).

### 4.1.2 Fishing Gear

Research on fishing gear began in 1982 with the introduction of the Turtle Excluder Device (TED) on shrimp trawl in the Arafura sea (Monintja, Daniel. R; Sujastani, T., Surachman, M., 1982). Furthermore, in 1997 research was carried out on the possibility of improving earlier model of TED (introduction of super shooter TED; Nasution, Ch., 1997).

The research was aimed at developing a type of TED that would be easy to use, would not affect the catch (fish and shrimp) and would be easily accepted by fishermen. The appropriate technology has still to be found and further experiments are required.

### 4.1.3 Oceanographic Condition

Several environmental factors which influence shrimp resources are rainfall, moon phase, seabed conditions, mangrove forest conditions and other oceanographic parameters. As previously mentioned, research on the environmental aspects in the Arafura waters continues to be conducted but is still insufficient.

Research was carried out on the mangrove community in Tanimbar Island (Pamudji *et al*, 1995), fertility levels and hydrology condition of mangrove water in Bintuni Bay (Sediadi A., Wenno, L.F., 1994) and fish community in waters surrounding mangrove in Bintuni Bay (Djamali, A. 1994). In January of 1996, a preliminary study was carried out on plankton and chlorophyll distribution patterns in the waters of Kai, Aru and Tanimbar (Sediadi, A. *et al*, 1991) , sediment composition in Sorong waters, Sele strait, Irian Jaya (Hermato, *et al*, 1987).

With regard to the abundance of shrimp resources, it was clearly found that:

(1) the mangrove is essential for shrimp resources abundance (Martosubroto, P. 1977).

(2) dwelling shrimp species depends on the nature of the seabed (e.g. *Penaeus mondon* is dominant in the Aru water compared to other areas in the Arafura waters because of specific seabed condition(Naamin, N., 1987). Waters with muddy beds allow the best catch.

(3) there is no direct or indirect correlation between the rainfall average and total production, nor between the rainfall average and catch per unit of effort.

(4) the optimal water depth ranges from 20 to 30 meters.

### 4.1.4 Socio-economic of Shrimp Fisheries and By-catch Utilisation

Research on socio-economic aspect concerning shrimp fisheries in the Arafura Sea is still limited. However, for instance, some analysis of technico economic parameters regarding shrimp trawl fishing units show more profitability with increased number of days of fishing operation in comparison to reduced days of navigation (Damanik E.M. 1997.

Other studies were recently carried out on fish handling, marketing and by-catch utilisation. (Chasanah, E., 1998; Chasanah, E. *et al*, 1993; Chasanah, E. *et al*, 1994; Chasanah, E. *et al* 1995; Hanafiah, T.A.R. *et al*, 1994; Malawat, S. *et al*, 1998).

Information gathered includes:

(1) identification of the intermediates within the marketing process from producers to consumers and individual benefits from by-catch trading (It was found that the largest margin is taken by the fish broker).

(2) catch handling methods according to catch composition and characteristics (shrimp and by-catch) with the aim to reduce the discard and increases the income.

(3) processing/technology for value addition to the by-catch.

### 4.2 Future Research

Several points should be seriously considered:

(1) accurate fisheries data concerning biology and economic parameters is a fundamental requirement, for shrimp fisheries, in general, as well as regarding by-catch. Such information is the basis for proper management of the fisheries;

(2) conditions of the environment are essential for resources sustainability and development; consequently continuous monitoring of environmental conditions is necessary;

(3) unavoidable by-catch should be utilised to a maximum, not only for immediate profit but first and foremost to provide animal protein to the coastal community; as a result, studies concerning fish product development, including using unavoidable by-catch, should be carried out;

(4) several by-catch reduction technologies exist; the problem is to identify a technology effective in the specific local conditions and which would be accepted by the local fishery industry; additional research is required in this field;

(5) to ensure proper management and development of any fishery, a solid and rational institutional system should be established, including for correct monitoring and control of on-going fisheries (Monitoring, Control and Surveillance system, MCS).

Based on the above-mentioned points, it is concluded that relevant research programmes should include:

(1) accurate and continuous data collection through log books and observers programmes;

(2) regular monitoring of resources and environmental factors;

(3) research for improving by-catch reduction technology and by-catch product development;

(4) institutional strengthening and development for proper shrimp trawl fisheries management.

## 5. SHRIMP TRAWL IMPACT ANALYSIS

It is reccognized that, within shrimp trawl fisheries, apart from shrimp which is the target, demersal fish (an estimate of around one hundred species (Naamin and Sumiono; 1982)) are also caught, often in large quantities, and other organisms such as crab, lobster, shrimp manthis, squid and octopus, occasionally sea snakes. It is worth mentioning that sea turtles are rarely caught because of the environmental conditions: the shrimp fishing grounds are relatively shallow, muddy and many areas with freshwater from rivers.

The additional, greatly, uncontrolled fishing effort on a large number of species other than shrimps may, of course, effect the overall resources, the ecosystem balance and the environment in general.

### 5.1 Impact on Shrimp Resources

The size of the shrimp caught is ranging (Sumiono and Sadhotomo, 1985; Iskandar *et al*, 1993) approximately 70-80 or 81-120 mm. However, it is observed that the size of the shrimp caught in Bintuni Bay and Sele is relatively small compared to the size of the same species caught in other waters.It is also observed that in the Aru watersthat the size of white shrimp is predominantly 30-40 and 41-50 (Sumiono, 1982). These seem reflecting excessive fishing and increasing fishing efforts carried out in certain areas.

Table 11 shows that fishing effort, in terms of number of days at sea, number of fishing days and number of haul from 1974 to 1996 in the Arafura waters tends to continuously increase while there is, at the same time, a sharp decrease in the average annual catch per haul.

**TABLE 11. Evolution of effort and catch per unit of effort during 1974-1996 in Arafura waters**

| Fishing activities per unit of vessel | 1974 | 1977 | 1980 | 1996 |
|---|---|---|---|---|
| 1. Number of navigation days | 222 | 247 | 309 | 308 |
| 2. Number of active fishing days | 184 | 212 | 287 | 281 |
| 3. Number of hauling | 1,342 | 1,561 | 2,238 | 2,303 |
| 4. Catch per hauling (kg) | 95 | 68 | 40 | 38 |

Sources: (1) Naamin, 1984
(2) Nasution, 1998

Increased fishing activity was observed in the Kaimana waters during 1974-1980 and then declined during 1981-1987.

**TABLE 12. Production, number of hauls and number of active shrimp fishing days in Kaimana waters**

| Year | Production of banana shrimp (ton, Head-on) | Number of hauling | Kg/hauling |
|---|---|---|---|
| I) 1974 | 872.0 | 12,709 | 69 |
| 1975 | 511.1 | 7,097 | 72 |
| 1976 | 958.9 | 16,165 | 59 |
| 1977 | 960.9 | 16,847 | 57 |
| 1978 | 788.2 | 14,763 | 53 |
| 1979 | 1,270.7 | 24,012 | 53 |
| 1980 | 1,150.9 | 27,167 | 42 |
| II) 1981 | 607.8 | 17,315 | 35 |
| 1982 | 624.2 | 17,415 | 36 |
| 1983 | 647.8 | 17,486 | 37 |
| 1984 | 538.3 | 16,127 | 33 |
| 1985 | 505.7 | 16,027 | 35 |
| 1986 | 593.9 | 16,846 | 35 |
| 1987 | 576.0 | 16,633 | 35 |

Sources: I. Naamin, 1984
II. Iskandar et al., (1993)

From Table 12 it can be noted that until 1980 an increase in effort was leading to an increase of total catch, while, however, catch per unit of effort tended to decrease. After a pick in 1980, the fishing effort was from 1981 -1987, at a lower level and at the same time, the catch per unit of effort. It was observed that after the pick of the fishing effort, the yield for a given effort was less than expected (57-59 kg/haul in 1976-1977 and 33-35 kg, only, in 1984-1987). This would indicate that shrimp fishing in these waters has reached the maximum level.

This observation was confirmed by Naamin, N (1984) which, when analysing data during 1974-1981, stated that, in general, white shrimp fishing, as a dominant species, has been overfished.

Table 13 presents for 1992-1995 the evolution of catch per unit of effort from one of the fishing companies which operates in the same fishing ground (Kaimana) while the fishing effort varies, with a tendency to decreasing. The yield does not really increase when the effort decrease. It probably shows that the shrimp resources have not fully recovered from past intensive exploitation.

The above interpretation most certainly depend greatly on the quality of the data and information gathered from shrimp fishing companies.

**TABLE 13. Catch, number of hauls and number of active shrimp fishing days in the Kaimana waters, from a shrimp trawler, "*PT. Dwi Bina Utama*"**

| Year | Production of banana shrimp (kg. head-on) | Number of Hauling | Kg/Hauling |
|---|---|---|---|
| 1992 | 16,590 | 1,097 | 23 |
| 1993 | 5,818 | 638 | 14 |
| 1994 | 6,235 | 390 | 24 |
| 1995 | 9,665 | 723 | 20 |

Further observations during 1990-1998 in the , Aru, Kaimana, Dolak and Bintuni waters collected from the trawler "*Bawal Putih II*" and other outrigger trawlers, do not show for the catch per haul (an abundance index) a clear tendency (Table 14).

**TABLE 14. CPUE of shrimp (kg/haul) of "*R.V Bawal Putih II*" shrimp trawler and other fishing vessels during 1990-1998**

| Year | 1990 | 1991 | 1992 | 1993 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| **Aru** | | | | | | | | |
| Other fishing vessel | - | - | | 29 | 25 | 20 | 26 | |
| BP II | 20 | 36 | | | 37 | 35 | 35 | 24 |
| **Kaimana** | | | | | | | | |
| Other fishing vessel | - | - | | | 37 | 27 | | |
| BP II | - | 40 | | | - | 35 | 25 | 40 |
| **Dolak** | | | | | | | | |
| Other fishing vessel | - | - | | | 34 | 28 | | |
| BP II | 30 | 52 | | | 25 | 34 | 37 | 40 |
| **Bintuni** | | | | | | | | |
| Other fishing vessel | - | - | | | 35 | 35 | | |
| BP II | 20 | 43 | | | - | 10 | - | |

For the entire Arafura waters, evolution of fishing effort, total catch and catch per unit of effort is outlined in Table 15 (for details please refer to chapter 2, fishing effort). It shows that fishing effort, which is described in number of hauls from 1990 to 1998, increases while total catch and CPUE remains relatively stable.

**TABLE 15. Catches, fishing effort and CPUE of shrimp trawlers in the Arafura sea from 1990 to1998**

| Years | Fishing effort (hauling) | CPUE (kg/hauling) | Catches (ton) |
|---|---|---|---|
| 1990 | 632,472 | 33 | 20,872 |
| 1991 | 883,350 | 37 | 32,684 |
| 1992 | 934,192 | 31 | 28,960 |
| 1993 | 777,163 | 25 | 19,429 |
| 1994 | 851,170 | 28 | 23,848 |
| 1995 | 781,660 | 34 | 26,576 |
| 1996 | 968,371 | 31 | 30,015 |
| 1997 | 957,768 | 34 | 32,564 |
| 1998 | 977,936 | 30 | 29,338 |

**TABLE 16. Shrimp catches composition in Bintuni, Aru, Dolak and Kaimana from 1992 to 1996**

| Shrimps | Bintuni | | | | | Aru | | | | | Dolak | | | | | | Kaimana | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 92 | 93 | 94 | 95 | 96 | 92 | 93 | 94 | 95 | 96 | 92 | 93 | 94 | 95 | 96 | 92 | 93 | 94 | 95 | 96 |
| Jerbung | 76 | 80 | 71 | 68 | 83 | 3 | 5 | 15 | 22 | 5 | 10 | 80 | 48 | 52 | 33 | 59 | 46 | 55 | 43 | |
| Tiger | 0,8 | 0.1 | 7 | 13 | 0.1 | 58 | 59 | 48 | 45 | 66 | 82 | 5 | 15 | 19 | 33 | 10 | 23 | 18 | 26 | |
| Dogol | 23 | 20 | 21 | 19 | 17 | 39 | 35 | 37 | 33 | 29 | 8 | 14 | 37 | 29 | 33 | 31 | 31 | 27 | 30 | |

Shrimp composition from several sub regions, has not changed significantly (see table 16).

Finally, it is observed that fishing gears and methods used by fishery operators do not vary much whatever the target species are, if any.

### 5.2 Impact on Fish Resources

Fish which is found as by-catch from trawl fishing in the Arafura sea is very important for the shrimp fishing industry. Unutilised by-catch will, most probably, greatly increase with the ever growing number of fish trawlers in the Arafura sea.

The quantity of landed fish does not only depend on the number of trawlers and fishing ground, but, also varies according to season. During the peak shrimp season, the quantity of by-catch retained tends to be minimal due to limits in fish hold capacity (see Annex 4).

The ratio of by-catch to shrimp in tropical waters is roughly estimated being, in general, about 10:1 (Allsopp, 1982). In Indonesia, several authors have presented estimations of this ratio in specific conditions: In 1981, when there were many trawlers still in operation (124 units), the ratio in Dolak, Kaimana and Aru waters was approximately 19:1 and 95% of the by-catch was utilised (Naamin and Sumiono, 1983). In 1991, when the number of trawlers operated in the Arafura sea was around 87 units, the ratio was approximately 8:1 to 13:1 (Widodo, 1991, Badrudin and Karyana, 1993). In the sub areas of Sele and Bintuni, in October to November 1992 the ratio of by-catch to shrimp was found being approximately 9:1 (Iskandar *et al*, 1993).

Between 1991 and 1998 data from a research vessels operating in the Arafura waters indicate that ratio fish:shrimp varies from 3:1 to 26:1, with an average of 10:1 (Table 17).

The large differences observed for this ratio probably greatly reflect the conditions on different fishing grounds exploited; however, the average still accords with the estimate given for tropical areas, in general, by Allsopp in 1982.

**TABLE 17. Ratio of shrimp and fish catches by Shrimp Trawler "RV Bawal Putih II" in Bintuni, Aru, Dolak and Kaimana**

| | Bintumi | | | | | | Aru | | | | | | Dolak | | | | | | Kaimana | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 90 | 91 | 95 | 96 | 97 | 98 | 90 | 91 | 95 | 96 | 97 | 98 | 90 | 91 | 95 | 96 | 97 | 98 | 90 | 91 | 95 | 96 | 97 | 98 |
| U | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| I | 3 | 4 | | 26 | | | 9 | 10 | 6 | 6 | 9 | 10 | 7 | 11 | 21 | 7 | 25 | 8 | | 5 | | 5 | 8 | 7 |

## 5.3 Impact of Shrimp trawl Fisheries on other Organisms

As part of the by-catch in shrimp trawl fisheries, other organisms are caught in addition to fish; these consist in small sizes of shrimp, crab, squila, shrimp manthis, sea cucumber, sea snakes, starfish etc.

These other organisms are making an overall economic loss due to the following:

(1) the cost of catching these, the task of sorting them from the target catch and of discarding.

(2) the potential economic value of the discard which might be better exploited when brought to market and given value with some processing.

**TABLE 18. CPUE (KG/haul) of shrimp trawler "RV. Bawal Putih II" during 1990- 1998 in the Arafura Sea.**

| | 1990 | 1991 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|
| **Aru** | | | | | | |
| Fish | 188 | 363 | 211 | 220 | 330 | 248 |
| Shrimp | 20 | 36 | 37 | 35 | 35 | 24 |
| Others | 16 | 5 | 11 | 15 | 26 | 26 |
| **Kaimara** | | | | | | |
| Fish | - | 189 | - | 176 | 184 | 189 |
| Shrimp | - | 40 | - | 35 | 25 | 40 |
| Others | - | 17 | - | 4 | 6 | 12 |
| **Dolak** | | | | | | |
| Fish | 199 | 597 | 517 | 258 | 934 | 310 |
| Shrimp | 30 | 52 | 25 | 34 | 37 | 40 |
| Others | 8 | 53 | 5 | 7 | 19 | 10 |
| **Bintuni** | | | | | | |
| Fish | 63 | 169 | - | 265 | - | - |
| Shrimp | 20 | 43 | - | 10 | - | - |
| Others | 2 | 2 | - | 13 | - | - |

**TABLE 19. Landing catch of by-catch shrimp trawler in Sorong 1999**

| No. | Month | Catches (kg) | Remarks |
|---|---|---|---|
| 1 | January | 97,500 | |
| 2 | February | 101,300 | Shrimp trawler company |
| 3 | March | 107,100 | 1. PT. ALFA KURNIA |
| 4 | April | 93,250 | 2. PT. DWI BINAUTAMA |
| 5 | May | 91,600 | 3. PT. WIFI |
| 6 | June | 109,150 | 4. IMPD |
| 7 | July | 96,115 | PT. MINA KARTIKA |
| 8 | August | 98,400 | PT. SAMUDRA GRAHA |
| 9 | September | 110,200 | |
| 10 | October | 99,700 | |
| 11 | November | 101,400 | |
| 12 | December | 93,215 | |
| | TOTAL | 1,198,570 | |

- the by-catch from shrimp fishing is provided to coastal communities for local consumption.
- the by-catch is collected by collectors, appointed by the District Fisheries Services in Sorong.

### 5.4 Impact of Shrimp Trawl on Seabed habitat Condition

The term of seabed habitat in this context means the condition of the biotic and abiotic environment which interact amongst themselves in order to maintain co-existence and equilibrium in certain ecosystems, such as the coral community, mangrove, sea grasses, etc.

Bottom fishing gear, such as trawls, either directly or indirectly affect the seabed and the quality of the environment and thismay in turn disturb the equilibrium of ecosystems.

The bottom habitats in the Arafura Sea have hardly been studied, after and before the utilisation of the shrimp trawl. Research activities concerning bottom sediments, biological oceanography or coastal ecosystems such as mangrove were carried out at Benton Bay, Sele Strait and the Aru Islands. However due to the inconsistency of time and space the information now available is very limited making it difficult to analyse the impact of shrimp trawl on the seabed and habitat conditions.

## 6. PERCEPTION OF SHRIMP EXPLOITATION SITUATION TODAY AND ITS IMPACT TO THE ENVIRONMENT

A survey was carried out to evaluate perception of stakeholders and local communities concerning shrimp exploitation. The results of the survey are reported below:

### 6.1 Perception of Industrial Group of Shrimp Fishing Operators

In general, half of the group now involved in shrimp fisheries still has a willingness to develop fleets now operating in the Arafura sea. The people in the industry consider that trawl is the most appropriate fishing gear to be used; however they consider also that the number of trawl authorized should not be increased. They consider that shrimp resource has reach an equilibrium point, and also observe that the financial aspect is on the break even point. The aforementioned shrimp fishing companies hope that Presidential Decree No. 39 of 1980 will be maintained or, if revised by another regulation, that the new text will allow to control trawl operations for limitating the number of vessels on each fishing ground, and will also prevent conflict with small scale fisheries using fishing gear other than trawl.

Around 38% of respondents from shrimp fishing companies stated that they always use by-catch reduction devices (or BED) as required within the Presidential Decree No. 85 of 1982; 25% stated that they use them only occasionally or were not aware whether or not they should use them (In respect to this, it is worth mentioning that only 25% believe that the use of a by-catch reduction device is an obligation while almost 38% believe that it is not); finally, 12% stated that they do not use any by-catch reduction device due to technical reasons.

67% of the people within the shrimp fishing industry consider that trawling has an impact on the biodiversity of living marine resources which is acceptable as is the rate of discard.

### 6.2 Perception of Non-shrimp Fishermen

Non-shrimp fishermen believe that the shrimp fishing industry should not be developed but kept as present. They agree on Presidential Decree No. 39 of 1980 about trawl banned and suggest that, for shrimp fishing, trammel net could be developed as an alternative to trawl. A few respondents consider that potential resource for shrimp is still important while others observe that the resource is decreasing.

Many non-shrimp fishermen recognize that they do not know much about the activities of the shrimp trawling industry; in particular, most of them do not know whether such fishery is still profitable or not, nor, whether fishermen use any by-catch reduction device.

This group has no idea of the number of shrimp trawlers now into operation and consequently they are not sure whether the fleet should be reduced or not. Some of the respondents consider that trawling on the bottom is very dangerous to the biodiversity of living marine resources, but, on the other hand, some others point out the fact that the damage to biodiversity is probably unavoidable. A majority of the respondents assume that discarding of by-catch when traling for shrimp is large and suggest that in order to reduce the potential negative impact certain fishing grounds should be closed.

### 6.3 Perception of People dealing with Environment Protection

Most of the respondents, among Environment Officers and NGO's, 83% observe that shrimp resources decrease and the same percentage consider that trawl is very dangerous for the biodiversity of living marine resources, while the rest consider that damage of biodiversity is acceptable. They assume that the ratio of discard-catch is very high within shrimp trawling fisheries and request the establishment of a closed fishing season and a reduction in the number of trawls used. Surprisingly, there is also among the same group the opinion (27%) that shrimp fishing industry can still be developed in the sea. 43% of the group consider that Presidential Decree No. 39 of 1980 regarding trawl banned should be modified.

### 6.4 Perception of Government Officers from the Directorate General of Fisheries

Among the staff of the Directorate General of Fisheries, around 40% consider that the shrimp fisheries industry still needs to be developed, however the same percentage think the opposite. According to them, trawl and Danish seine are the most appropriate fishing gears for catching shrimp. 50% of respondents suggest that presidential Decree No. 39 of 1980 should be abolished. They also state that by-catch reduction devices should always be used. They observed that trawling in the South East of the Arafura Sea, off Merauke (Sub-area V) is still profitable while the fishery would affect seriously the biodiversity of the resources and that the discard-catch ratio is very high. Consequently, they state that the number of trawlers in the area should be reduced. Some closure of the fishing season is also suggested as management measure.

### 6.5 Perception of Traders and Shrimp Exporters

Most of them belong to GAPPINDO, a fisheries businessman Organization which includes fish traders, managers of cold storage facilities and fisheries exporters. They consider that the shrimp fisheries industry can still be developed. For it, they believe that trawl is the most appropriate fishing gear to be used, however, surprisingly, they consider that Presidential Decree No. 39 of 1980 about trawl banned should be maintained.

They consider that shrimp potential is now exploited to its optimum and observé that the trawl industry is at its break even stages.

The majority believe that shrimp trawlers always use by-catch reduction devices when trawling for shrimp but 30% do not believe it. Only one third considers that the use of a by-catch reduction device should be compulsory while the rest that it should not be. According to a majority of the traders and shrimp exporters the impact of trawl should be acceptable, in general, and they assume that the discard-catch ratio when trawling for shimp is, in general, rather low. In term of management for the conservation of shrimp resources and environment, the group suggests to close certain fishing grounds or fishing seasons, or, to combine the two methods.

### 6.6 Perception of Scientists

Two third of the scientists consider that the shrimp potential yield is large while the rest recognizes that they really do not know. The later are requiring further and more complete research for assessment of the resources. The scientists observe, in general, that trawl is the proper fishing gear for exploiting shrimp resources and they consider that shrimp fishing industry can still be developed, with some increase of the number of trawlers. For that purpose, they consider that the Presidential Decree No. 39 of 1980 should be revoked.

Most of the scientists observe that by-catch reduction devices are used only occasionally by trawlers in the Arafura Sea. Around 50% of them consider that the use of such devices should be made compulsory, however, 50% recognize that the design of these should be improved.

The scientists acknowledge, in general, that trawl has a real impact on the biodiversity of living marine resources.

Most of them consider that the high discard-catch ratio when trawling for shrimp is unavoidable, but 33% observe that it is now very high. A closed fishing season, quota system of catch and regulation of catch effort are suggested as conservation measures.

## 6.7 Perception of Shrimp Fishing Industry in Respect to Modification of Fishing Through the Adoption of Environmentally Friendly Techniques and Practices

Environmentally friendly shrimp fishing implies fishing gear and practices which are not harmful to fisheries resources and its environment, allowing sustainable exploitation.

It is worth reminding the Ministerial Agriculture Decree, No. 02/Kpts/Um/1/1975, dated on 2 January 1975 for sustainable fisheries in the Irian Jaya waters (Arafura) which , requires:

a) all measures to keep resources sustainability in the Arafura sea.
b) closure of all fishing activities with trawl along the Irian Jaya coasts (Arafura) and all islands up to the 10m isobath line
c) no use of stretch mesh in the codend less than 30 mm
d) prohibition of all shrimp fishing activities in the Irian Jaya waters with pair trawl.
e) the number of vessel operated is regulated and adjusted every year, on 1 April, for each fish/shrimp stock.

However, the implementation of this Decree, particularly shrimp trawl industry in the Arafura Sea is not actually effective

The closure of the fishing grounds less than 10 meters in depth is not implemented and shrimp trawlers often fish in more shallow waters. In addition, it is observed that some grounds, for e.g. Benton Bay, where the average depth is more than 10 meters, are, in fact, nursery grounds which should be protected. Practically, trawling is operated in shallow waters, on some nursery grounds; the fishery community is fully aware of it but there is a lack of control, in general.

However, it is worth observing that certain areas, e.g. Paparan Sahul waters are very shallow (10 m depth is reached at more than 15 km from the coast) and, in 5 m depth, mature stages of shrimp are found.

The regulation concerning the minimal mesh size in the codend (30 mm), is not effective because, practically, codends with 45 mm meshsize still retain juvenile shrimp (21.5 mm carapace size or 3 months of age). Therefore, implementing the 30 mm mesh size regulation does not mean that no shrimp juvenile are caught (Naamin, N. 1984).

The regulation of fishing effort is fully feasible with a limitation of the number of fishing licenses, the size of vessels and number and size of nets. In addition, as already mentioned, shrimp trawlers are also required to use on their trawl some device reducing the by-catch (BED) (Presidential Decree No. 85 of 1982).

The Association of Shrimp Trawl Companies, HPPI, considers that the quantity of fish taken as by-catch when trawling for shrimp, is relatively small. It observes that for 453 shrimp trawlers operated in the Arafura Sea, the production is 34.330 tonnes/year and only 206.000 tonnes/year as a by-catch. Anyway, it is pointed out that the landings of by-catch are rather low due to operational factors and local socio-economic conditions. The operational factors include the small size of vessels (which have not enough room for storage of by-catch), the time required for handling this by-catch and short sailing times between fishing grounds and landing places (Ambon, Sorong). Socio economic factors include the decrease in the price of by-catch fish on the local market and costs for storage and transportation of it.

It is worth mentioning that recently the governor of a district, Sorong, in the North West of the Arafura Sea required that the by-catch should be landed during the peak season.; as a result, in 1999, more than 1000 tonnes of fish were landed in that district.

Regarding the utilisation of by-catch reduction devices on board vessels, the shrimp trawling operators observe that it generates a loss of shrimp catch which they estimate to about 15% for each haul; they also consider that size and design of the by-catch reduction devices should be adjusted to the size of the trawl and of the vessel on which it has to be handled (the actual devices are considered as cumbersome and creating problems when setting and hauling net).

## 6.8 Impact of Shrimp trawling Fisheries on Socio-economic Conditions for Local Communities

### 6.8.1 Employment

Shrimp trawling has brought work opportunities to local communities as for crew members and ashore, in processing, packing and exporting activities. It is worth mentioning that 3,000 people are employed at sea only in this particular industry.

### 6.8.2 Fishing Ground conflicts

In this respect, refeerence is made to the Ministry of Agriculture Decree No. 02/Kpts/Um/1/1975 concerning the sustainability of fishery resources development in the Irian Jaya waters which states that all trawling activities are prohibited in less than 10 meters depth.

However, shrimp trawlers often operate close to the coast (in a restricted fishing zone) even estuarine, first of all because the depth steeply increases in certain areas, even in certain estuaries..

There are frequent conflicts between local small-scale fishing communities and shrimp trawlers operating outside legal fishing zones.

### 6.8.3 Distribution of By-catch of Shrimp Trawl

The District Fisheries Sciences of Sorgong reports that in 1991 1.198,5 tonnes of by-catch from six shrimp trawling companies were utilised for local consumption in the North West of the Arafura Sea. (Table 19).

For this reason, the local communities there consider that:

(1) the shrimp fishing industry is important and trawling is considered as the appropriate method.
(2) the number of shrimp trawlers should be kept as it is now.
(3) the by-catch reduction (excluder) devices are used only occasionally. The fisheries communities urge that the use of this device should be made compulsory, however, they are recognizing that the design of of these devices should be improved to make sure that these do not affect the trawl operations. Relevant tests and demonstrations should be organised.
(4) it is assumed that the shrimp resource in the Arafura Sea is exploited near by its optimum. Stock assessments should be carried out within the near future.
(5) most people assume that some marine biodiversity degradation results from trawling, however, additional research should be carried out to confirm it.
(6) it is observed that trawling generates a lot of discards and considered that this should be properly reduced.
(7) closed season, closing of certain areas or fishing grounds are amongst the appropriate management measures to be applied. Controlling the fishing effort is also a necessity.

## 7. PROPOSED ACTION PLAN

Management plans for shrimp trawl fisheries in the Arafura sea has not yet been set up, even though it would be very suitable due to existing serious problems. According to Pollock. B. (1999) an accurate regulation for proper management is still necessary which should include Monitoring, Control and Surveillance (MCS) of fleet operations.

Such a plan should also incorporate research programmes including stock assessment, environmental aspects, post harvest and by-catch issues, socio-economic conditions, policy, consultation process, including with stakeholders.

The first step is to complete the information regarding shrimp fisheries in the Arafura sea and to find solutions. Considering the existing difficulties/problems, the issues to be considered should include:

(1) jurisdiction (including fishing authorizations), and management structures;

(2) fisheries management taking into account all aspects in a global perspective, i.e. including biological, social and economical aspects, implementation of existing regulations (in particular, utilisation of by-catch reduction devices, fishing zones, fishing license, etc.) and fish utilization and marketing;

(3) stock assessment and including monitoring of resources exploitation and survey/monitoring of related environmental parameters;

(4) Monitoring Control and Surveillance of fishing activities, MCS: relevant structures and human resources;

(5) consultation with stakeholders and extension work; consultation and coordination among government institutions;

(6) post harvest processing, in particular, for by-catch utilisation and product development.

Considering the above mentioned issues, it can already be assumed that a successful reduction in the impact of shrimp trawling on living marine resources in Indonesia, will anyway require:

(1) awareness campaign regarding negative impact from shrimp trawling;

(2) assessment of shrimp resources;

(3) assessment of the fishing technology in use and demonstration of environmentally friendly gear and practices;

(4) elaboration of the overall appropriate strategy and presentation to stakeholders;

(5) implementation procedures;

(6) data and information system regarding shrimp fishing, made at the disposal of stakeholders and National Committee members;

(7) Monitoring Control and Surveillance system, MCS.

## 8. CONCLUSION

1. Several assessments of shrimp resources in exploitation in the Arafura Sea have been carried out, based on the analysis of commercial fisheries. All results agree that the level of shrimp fishing has already reached a heavily exploited stage. Further more complete research is, however, still necessary.

2. The use of by-catch reduction/excluder devices is compulsory on board all trawlers in the Arafura sea. This creates problems for fishing operations and generates some loss of shrimp. In general, the fishing operators have still not perceived the benefit from using such devices. Tests on improved by-catch reduction/excluder devices and demonstration of these should be carried out.

3. To date, management of shrimp fisheries has still not been given the appropriate priority. The actual fisheries regulation is based on Fisheries Law No. 9/1985. Besides the general fishery regulation, the management of shrimp fisheries makes reference to the Presidential Decree (Keppres) No. 039/1980 and to Keppres 085/1982 which states the obligation to use by-catch reduction devices, BED, when trawling in the Arafura Sea.

4. Research activities, in particular before 1982, concerning biology and fish population dynamics have been limited so far, as well as those regarding fishing gears, environment, post harvest technology and socio-economy. Accurate and updated data on yield and effort are still missing to elaborate accompanying/routine research programmes for the development of responsible fisheries. Research budgets are limited (especially when the use of research vessels is required). Therefore, to conduct the appropriate research it is necessary to establish collaborations with the private sector in the country and with foreign research institutions (through networking). In addition, it is worth mentioning that research should, in most of the cases, be multi-disciplinary in order to get answers for complex problems.

5. The observation of the actual shrimp trawl fisheries in the Arafura Sea tends to suggest that care should be taken when exploiting these resources. Shrimp and fish resources seem to have been under high pressure for the last 30 years. Indications of resources deterioration are perceived with the size of the fish and shrimp which are smaller and smaller and the reduction in average catching yield and catch per unit of effort, in general. Apart from this, the status of environment and ecosystems cannot be properly evaluated due to insufficient data.

6. In general, shrimp trawl fisheries stakeholders are aware of the importance of reducing the by-catch and discards. They have, in principle, a positive attitude regarding the implementation of environmentally friendly technology for the sustainability of fisheries; however, only a series of tests and demonstrations on improved/new technologies will allow to increase interest and commitment of the stakeholders and lead to practical changes in the fishing practices.

7. The problems are complex and to resolve these, activities should be planned carefully. There should be first an effort for correct identification of problems, then, the design of a strategy and relevant programme and, finally careful planning of the execution of it. At the same time, it is essential keeping in mind that the shrimp fisheries stakeholders are also attempting to solve a number of related problems and that they should, therefore, be closely associated at all stages of the programme. For shrimp fisheries in the Arafura Sea, the relevant programme is already in the pipeline for the next five years and it includes the establishment of a National Committee, increasing of public awareness, the introduction of environmentally friendly fishing gear and their utilization, new assessment of shrimp potential resource, the establishment of sdata bases for scientifc purpose and networking facilities for research.

**Appendix 1. List of Landing Catch of By-catch Fishes in Ambon January 1997 – June 1998**

| No. | Nama Lokal | (%) | Species | Nama Perdagangan | Price per pan (Rp/8 Kg) |
|---|---|---|---|---|---|
| 1. | Aru Fish | 24.1 | Carangioda tiumerosus Cynoglosus sp.<br>Decapterus russelli<br>Ipenepbelus rivelatus<br>Leiognatbus equulus<br>Megalapis cordyla (Linnaeus)<br>Nemipterus isacantbus<br>Priacantbus macracantbus<br>Psenopsis tiumerosa (Munro)<br>Psettodes erumei<br>Pseudorbombus malayanus<br>Saurida tumbil<br>Upeneus sulphureus (Curier) | | 3,000,145.00 |
| 2. | Irian fish | 32.2 | Argyrosomus sp.<br>Austranibea oedogenys<br>Johnius (Johcops) vagleri<br>Johnius (Johnius) coitor<br>Otolithes ruber<br>Polydactylus nigripinnis | | 2,500-16,500 |
| 3. | Tiga Waja/ Gulamah | 6.4 | Pseudiciena spp | Croaker | 5,000-16,500 |
| 4. | Bubara | 1.6 | Caranx spp | Butter fish | 5,500-23,000 |
| 5. | Teri/Puri | 0.7 | Stelephorus sp. | Anchovy | - |
| 6. | Lema | 0.4 | Rastrelliger sp. | Indo-Pacific stripped mackarel | 8,000-22,500 |
| 7. | Sikuda/ Lencam | 1.6 | Lethrinus spp. | Emperor | 9,000-22,500 |
| 8. | Bawal | 0.2 | Velifer sp, Formio sp, Pampus sp. | Black and silver pomfret | 5,000-17,500 |
| 9. | Bulus-bulus | 1.2 | Sillago spp. | Whiting | 4,000-16,500 |
| 10. | Sebelah | 0.5 | Psettodes spp. | Indian halibut | - 14,500 |
| 11. | Layur | 0.1 | Trichiurus spp. | Hairtail | 2,250-14,000 |
| 12. | Merah | 0.03 | Lutjanus spp. | Red snapper | 12,500 |
| 13. | Mulut tikus/ Kuro | 0.01 | Elethoronema spp. | Giant theadfin | 8,000-11,000 |
| 14. | Kurisi | 0.2 | Nemipterus spp. | Threadfin bream | 8,000-11,000 |
| 15. | Manyung | 0.03 | Arius spp. | Marine catfish | 14,000 |
| 16. | Kerapu | 0.02 | Epinephelus spp. | Grouper | 7,500-22,500 |
| 17. | Cogi-cogi/ Tiga waja | 0.02 | Johnius spp. | Croaker | 5,000-16,500 |
| 18. | Bibi/buntal | 0.01 | Lagocephalus sp. | Puffer fish | 4,000-12,500 |
| 19. | Kakap | 0.03 | Lates spp | Giant seaperch | 4,000-5,000 |
| 20. | Cumi bunga | 7.2 | Loligo spp. | Squid | 7,000-13,750 |
| 21. | Cumi batu | 9.0 | Sepia spp | Cuttlefish | 6,000-24,000 |
| 22. | Gurita | 4.1 | Octopus spp. | Octopus | 12,000-85,000 |
| 23. | Udang krosok | 9.1 | Metapenacus spp | | 5,000-11,500 |
| 24. | Udang poleng | 0.02 | | | 6,500-12,500 |
| 25. | Kepiting | 0.7 | Carpilius spp<br>Portenus hastatoides<br>Podothalmus vigil<br>Scylla spp. | Coral crab<br>Swimming crab<br>Blue crab<br>Mud crab | 5,500-16,000 |

*Notes :* * *common name*
** *total landing* = 1551.81 t
*** *classification given by boat crews*

**REFERENCES**

Allsop, W.H.L., 1982. Use of fish by-catch from shrimp trawling: future development. *In* Fish by-catch bonus from the sea: report of a technical consultation on shrimp by-catch utilisation held in Georgetown, Guyana, 27-30 October 1981. Ottawa, Ont., IDRC: 29-50

Badrudin dan Karyana, 1993. Proporsi Komposisi Hasil tangkapan Sampingan Pukat Udang di Perairan Maluku-Irian Jaya. Jurnal Penelitian Perikanan Laut No. 79. Balitkanlut, Jakarta: 14-23.

Direktorat Jenderal Perikanan, 1977-1999. Statistik Perikanan Indonesia tahun 1976-1977. Diterbitkan setiap tahun.

Ditjenkan, 1995. Evaluasi Dampak Penghapusan *trawl* (Keppres No. 39/1980) terhadap Sumber Daya ikan di Laut Arafura, Cilacap dan Kalimantan barat. Laporan Proyek Pengembangan dan Pemanfaatan Sumber Daya Perikanan Laut. Ditjenkan (Tidak diterbitkan).

Iskandar, B., Sumiono, B. dan Sarjana, 1993. Penelitin Potensi Udang dan Hasil Tangkapan Sampingan di Perairan Maluku dan Irian Jaya. Laporan Penlitian Balitkanlut (Tidak dipublikasikan).

Naamin, N., 1984. Dinamika Populasi Udang Jerbung (*Penaeus merguiensis* de Man) di Perairan Arafura dan Alternatif Pengelolaannya. Disertasi Doktor. Fakultas Pasca Sarjana IPB: 281 hal.

Naamin, N., 1987. Dinamika Populasi Udang Jerbung (*Penaeus merguiensis* de Man) di Perairan Arafura dan Alternatif Pengelolaannya. Jurnal Penelitian Perikanan Laut No. 42. Balitkanlut, Jakarta: 15-24.

Naamin, N. dan Sumiono, B. 1983. Hasil Sampingan (*by-catch*) pada Penangkapan Udang di Perairan Laut Arafura dan sekitarnya. Laporan LPPL No. 24/1982. BPPL, Jakarta: 45-55.

Naamin *et al.*, 1992. Pedoman Teknis Pemanfaatan dan Pengelolaan Sumber daya Udang Penaeid Bagi Pembangunan Perikanan. Seri Pengembangan Penelitian Perikanan No. PHP/Kan/PT/22/1992. Badan Litbang Pertanian: 89 hal.

Nasution, Ch., 1998. Highlight of shrimp trawling in the Arafura Sea: fleet, shrimp catch and export in 1995-1996. Paper in Programme of FAO's Cooperative Research Network in Asia and Indian Ocean Region on Selective Tropical Shrimp Trawling. Res. Inst. For. Mar. Fish (Unpublished).

Pauly, D. and Neal, R. 1985. Shrimp vs Fish in Southeast Asian: the biological, technological and social problems *In* Arancibia, A.Y. (Eds.): Recources Pesqueros de Mexico: La pasca acompanante del camaran. Progr. Univ. de Alimentos. Inst. Cienc. Del Mar. Y. Limnol. Inst. Nacl. De Peasca, UNAM, Mexico, D.F. 748p.

Suharyanto, 1997. Laporan Survai Pengamatan Sumber Daya Perikanan Demersal menggunakan KM Bawal Putih II di Perairan Kawasan Timur Indonesia (Januari 1997-Juli 1997). BPPI Semarang (Tidak diterbitkan).

Suman, A., Budihardjo, S. dan A. Widodo, 1993. Stok Sumber Daya Udang di Perairan ZEE Selatan Irian Jaya. Jurnal Penlitian Perikanan Laut No. 79. Balitkanlut, Jakarta.: 92-98.

Sumiono, B. 1982. Survai Udang dengan KM Binama VIII di Perairan Arafura, September 1982. Laporan Survai BPPL: 12 hal. (Tidak diterbitkan).

Sumiono, B. dan Sadhotomo, B. 1985. Perbedaan Hasil Tangkapan Pukat Udang dan *trawl* di Perairan Teluk Bintuni, Irian Jaya. Jurnal Penlitian Perikanan Laut No. 33. Balitkanlut,Jakarta.

Sumiono, B. dan Priyono, B.E. 1997. Sumber Daya Udang dan Krustasea lainny *lalam* Priyono, B.E., Widodo, J., Azis, K.A., Merta, I.G.S., Djamali, A. dan Tampubolon, G.H. (Eds.): Potensi dan Penyebaran Sumber Daya Ikan Laut di Perairan Indonesia. Buku II. Ditjenkan: 80-111.

Sumiono, B. dan Priyono, B.E. 1998. Potensi Sumber Daya Udang *penaeid* dan Krustasea lainnya di Perairan Indonesia. Makalah diajukan pada Revisi Buku Potensi (Tidak diterbitkan).

Sumiono, B., Soselisa, Murtoyo, T.S. 1997. Survei Laju Tangkap Udang dan Ikan Demersal dengan KM Bawal Putih II di Laut Arafura, Sub area Kaimana (Agustus-September 1997). Balai Penlitian Perikanan Laut Jakarta (Tidak diterbitkan).

Sunarya, Sumiyanto, dan Sutimantoro, W. 1995. Volume dan Ukuran Udang Laut Kaitannya dengan Mutu dan Kelestarian, Contoh Bahasan untuk Daerah Sorong, Irian Jaya. Balai Bimbingan dan Pengujuan Mutu Hasil Perikanan, Jakarta: 7 halaman (Tidak diterbitkan).

Widodo, J., 1991. By-catch assessment of the shrimp fishery in the Arafura Sea and its adjacent waters. Jurnal Penelitian Perikanan Laut No. 63/1991. Balitkanlut, Jakarta: 43-49.

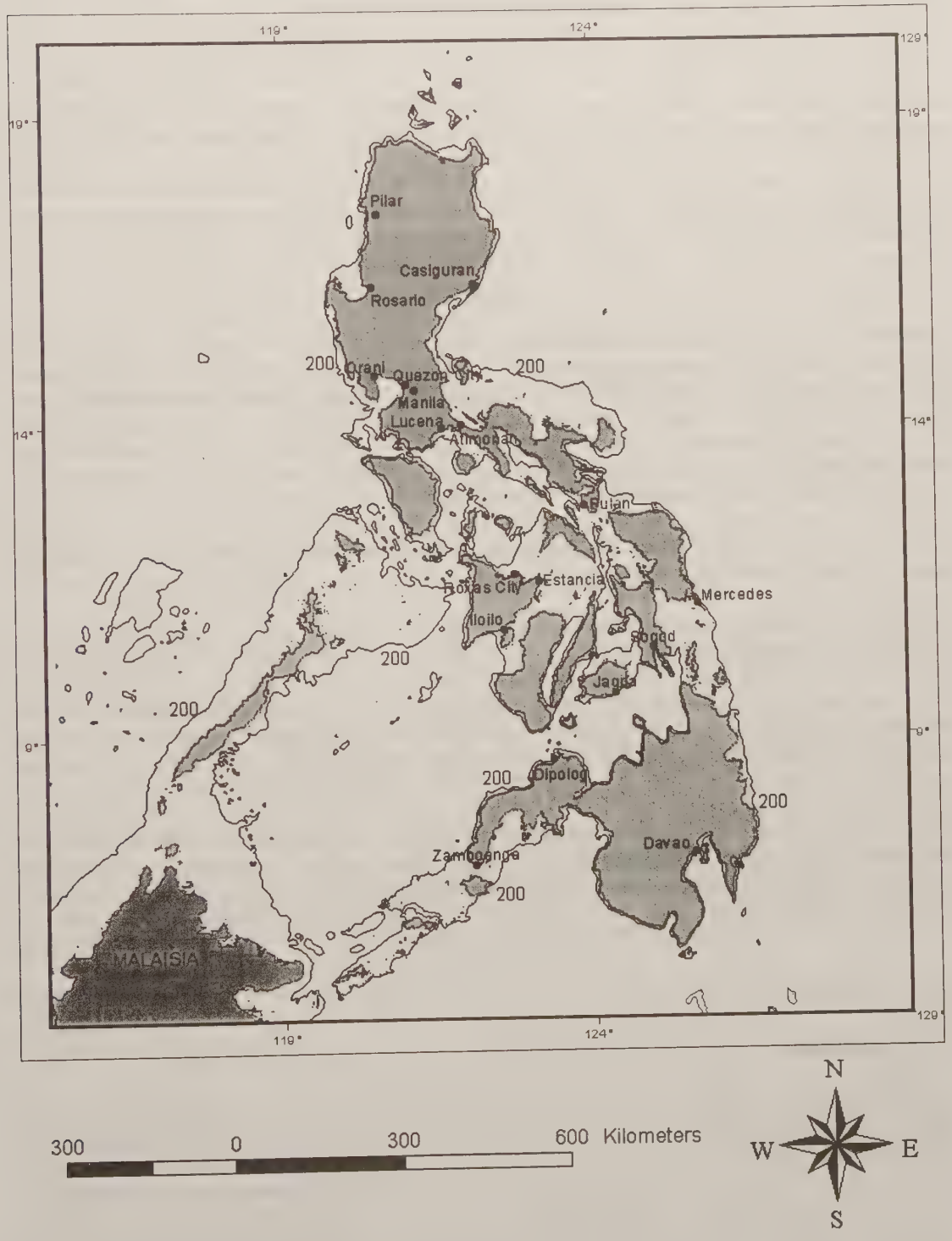
Widodo, 1997. Laporan Survai Pengamatan Sumber Daya Perikanan Demersal menggunakan KM. Bawal Putih II di Perairan Kawasan Timur Indonesia (November 1995-April 1996). BPPI Semara DAFTAR PUSTAKA.

## THE PHILIPPINES

### SHRIMP TRAWL FISHERIES IN THE PHILIPPINES

(National Report presented to the GEF/UNEP/FAO Workshop in the Reduction of the Impact of the Shrimp Fisheries, Denpasar, Indonesia; 6-8 March 2000)

by Jonathan O. Dickson, National Coordinator (Chief, Fishing Technology Division
Bureau of Fisheries and Aquatic Resources; 860 Arcadia Bldg., Quezon Avenue; Quezon City, Philippines; Tel # 632- 372-5051 Fax # 632-372-5056; email: bfarnmfd@info.com.ph)



Abstract

In 1997, the catch of shrimp was 7 156 t (90% *Acetes*) from the industrial fleet (445 vessels in 1997) and 25 334 t from the artisanal sector (over 50% of the catch are white shrimp (*P.merguiensis)* and endeavour prawns *(Metapenaeus ensis)*, 34% are *Acetes;* push net, "baby trawl", fyke net, fish coral, gillnet beach seine and filter net are the most common gear*)*.

Shrimp constitute only 10% of the total catch in trawl fisheries. Discard rates are unknown but likely to be relatively small as there is a market for most of the captured fish.

Shrimp mainly go to the local markets. Small-sized fish are utilized as fish feed for aquaculture.

All vessels need a licence to fish. Mesh sizes less than 25 mm are not allowed in shrimp fishing. Partial/total closure of some trawl areas are now implemented due to declining catch rates.

In order to ensure sustainability of the shrimp fisheries the challenge is to develop solutions that retain bigger fish allowing juveniles and turtles to escape while not causing an immediate economic loss for the fishers.

Resumen

En 1997, las capturas de camarón reportadas por la flota industrial (445 embarcaciones en 1997) alcanzaron las 7.156 toneladas métricas (90% *Acetes*), mientras el sector artesanal reportó 25.334 toneladas métricas ese mismo año. Más del 50% de las capturas artesanales estuvieron constituidas por camarón blanco (*P. merguiensis*) y langostino "endeavour" (*Metapenaeus ensis*), el 34% por *Acetes*. Las artes de pesca utilizadas más frecuentemente son: red de empuje ("push net"), red de arrastre menor ("baby trawl"), red falsa ("fyke net"), corral de peces ("fish coral"), red de enmalle ("gillnet"), red de orilla ("beach seine") y red filtrante ("filter net").

El camarón constituye sólo 10% del total capturado en la pesca de arrastre. Se desconocen las tasas de descartes, pero al parecer son relativamente bajas dado que existe un mercado para la mayor parte del pescado capturado.
El camarón se destina principalmente al mercado local. El pescado de talla pequeña se emplea en la elaboración de alimento para peces de acuicultura.

Todas las embarcaciones de pesca requieren una licencia para llevar a cabo la actividad. No está permitido el uso de abertura de malla inferior a los 25 mm en la pesca de camarón. Actualmente se implementa el cierre parcial o total de algunas áreas de arrastre debido a la caída en las tasas de captura.

Con el fin de asegurar el rendimiento sostenible de la pesquería camaronera, el reto es desarrollar soluciones que permitan retener los peces más grandes, permitiendo al mismo tiempo el escape de juveniles y tortugas sin ocasionar pérdidas económicas inmediatas a los pescadores.

## 1. INTRODUCTION

## A. Location

The Philippines, an archipelagic country composed of over 7,100 islands, is endowed with a vast expanse of marine and inland water resources. It is situated in the Western Pacific and bounded on the east by the Pacific Ocean, on the west by the Luzon Sea, in the South by the Celebes Sea and Bornean Waters just a few degrees north of the equator, and in the north by the Taiwanese waters. Its territorial waters as defined in the 1898 Treaty of Paris had an area of about 1,666,000 $km^2$ but with the promulgation of the Exclusive Economic Zone, the territorial marine area is increased to 2,200,000 $km^2$. It has a land area of 300,000 $km^2$ and about 17,460 km of coastline. The coastal and oceanic waters occupy 12% and 88% of the total marine areas respectively (Figure 2).

## B. Fisheries Industry

The fisheries industry is sub-categorized into municipal, commercial and aquaculture. The municipal refers to fishing within the municipal waters (0-15 km from shore) using fishing vessels of three (3) gross tonnes or less, or fishing not requiring the use of fishing vessels. The commercial sector refers to taking of fishery species by passive or active gear for trade, business or profit beyond subsistence or sports fishing using vessels with more than three (3) gross tonnes. Aquaculture sector involves fishery operations engaged in all forms of raising and culturing fish and other fishery species in fresh, brackish and marine areas.

In 1997 the contribution of the fisheries industry to the country's Gross Domestic Product (GDP) and were 2.8% at current prices and 3.8% at constant prices. Total fish production in 1997 reached 2,766,663 MT, valued at PhP80.7 B, of which 33.4% came from municipal fisheries (924,466 MT), 32.0% from commercial fisheries (884,651 MT) and 34.6% from aquaculture. From 1988-1997, the average annual growth rate was 2.2%. Positive growth of 5.3% was posted by aquaculture. Inspite of the slight decrease by 0.09% of the output of the fishing industry in 1997, aquaculture still posted a 6.7% increase in production.

The municipal resources consist mostly in fishes. Invertebrates like blue crabs and squids also contribute significantly to the production. The five (5) major fish produced based on 1996 statistics were fimbriated sardines, squid, anchovies, frigate tuna and indian sardines. The fishing gears being used are generally simple, low cost, and easily operated by fishermen using motorized and nonmotorized fishing boats ("bancas"). The most common fishing gears are gillnet, hook and line, beach seine, fish corral, ringnet, trawl, spear, longline and danish seine. From 1992 –1995, gillnet was the most productive. The major fishing grounds are Visayan Sea, Bohol Sea, East Sulu Sea, Moro Gulf and Guimarras Strait.

As far as the commercial sector is concerned, in 1996, 27% of its production came from the National Capital Region with as major species caught: roundscad, sardines and tuna. The main fishing gears are purse seine, ringnet, trawl, danish seine and bagnet while the productive fishing grounds are West Palawan waters, Tayabas Bay, Lamon Bay, Manila Bay, Sibuyan Sea and Cuyo Pass.

## 2. THE TRAWL INDUSTRY

Trawl is recognized as one of the most-efficient fishing gear for harvesting shrimps. This method has become popular in the country before and during Japanese colonization in the 1940's. Umali (1950) reported that Japanese fishermen were already operating beam trawls at that period. Just after, pair trawling (two-boat-trawling) was also introduced but in limited quantities. After the liberation period, the Americans popularized otter trawling using one-boat. This was made possible through explerimental trawling carried out by Warfel and Manacop (1950) in some parts of the country. With the remarkable efficiency of the gear, otter trawl was widely accepted and adopted by the industry in the 1960's. In 1967, there were 600 units in operation in Philippine waters (Encina, 1976). After three decades, licensed commercial trawlers in 1997 reached around 445 units (62% classified as small-commercial (i.e. 3 to 20 GT); 37% medium-commercial (20 to 150 GT); and 1% large-commercial trawlers (150 GT and above) (BFAR Profile, 1997). Mini-trawl or "baby-trawl" operating in coastal and inshore parts of the country is unaccountable, but, estimated to be common.

Municipal and commercial trawling can be distinguished within the trawl industry sector of the Philippine fisheries: The municipal trawling sector utilizes wooden dugout fishing crafts or "*banca*" measuring 5 to 12 m over-all length. Such crafts are propelled by 10-90 HP gasoline or diesel engines. The commercial trawl sector utilizes bigger-sized boat with greater engine power. As already mentioned above, the later can be further classified as: small-commercial (3 to 20 GT); medium-commercial (20 to 150 GT), and, large-commercial type (150 and beyond). The boat more than 15 m in length, with engines ranging 150 to 500 HP areoften equipped with mechanized pulleys for hauling the net.

Trawl has been contributing to around 13% of the Total Annual Production from 1992-1995 (Table 1). At this time, in the municipal waters, trawl ranked 6$^{th}$ among the most productive municipal fishing gear after gillnet, hook and line, beach seine, fish corral and ring net according to Bureau of

Agricultural Statistics. In the commercial fisheries sector, trawl is the fifth, after purse seine, ringnet, danish seine and bagnet in terms of over-all production.

The most common trawling method consists in single trawling, the net being horizontally opened by two wooden otter boards. The vertical openings may be slightly adjusted depending on the targeted species. High-vertical opening trawls or the semi-pelagic fish trawls being towed at high speed (i.e., averaging 4 knots or greater) can capture fast-swimming fish

**TABLE 1. Contribution of the Trawl Fisheries Sector to the Total Municipal and Commercial Production from 1992-1995**

| Year | Trawl (Municipal) | Total Municipal Production | Trawl (Commercial) | Total Commercial Production |
|---|---|---|---|---|
| 1992 | 36,705 | 854,687 | 90,547 | 804,866 |
| 1993 | 41,923 | 803,194 | 86,965 | 945,431 |
| 1994 | 27,277 | 786,847 | 88,423 | 885,446 |
| 1995 | 23,517 | 785,369 | 66,089 | 926,887 |
| Contribution by sector (%) | 4.01 | | 9.66 | |

Source: Bureau of Agricultural Statistics.

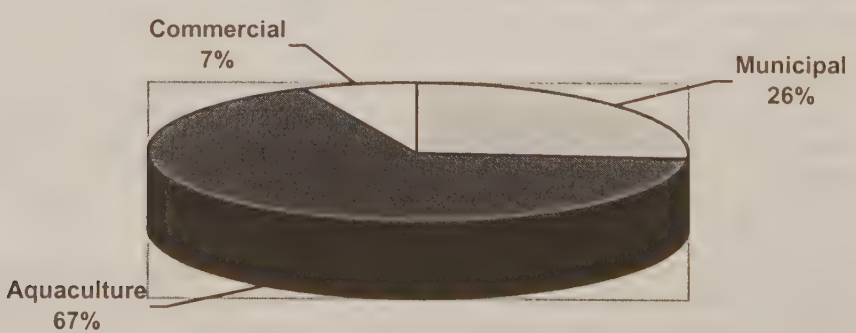
On the other hand, low-vertical opening trawls or shrimp trawls, are normally scrapping heavily the bottom to capture shrimp and fish dwelling on it; they have greater drag and are towed at slower speed. In general, the codend is made of single layer netting with protective chaffer using mesh sizes of 3-4 cm although, smaller mesh sizes are frequently used in coastal waters (1-3 cm).

## 3. SHRIMP FISHERY

### 3.1 Shrimp Resources

The exploitable shrimp resource in the country consists in species of the *Pendied* family. These are the *Penaeus merguiensis* (white shrimp), *P. semisulcatus* (tiger shrimp) and *Metapenaeus ensis* (endeavor shrimp). Other important shrimp species include the *Acetes* as raw material for shrimp paste and brown rough shrimp (*Trachypenaeus fulvus*) usually processed in dried form. Many other species are found throughout the country in marine waters and, also, in brackish and fresh waters but in less quantity (Del Mundo, 1990; Caces, 1973; Motoh, 1980).

**Figure 1. Percentage of shrimp produced by sector**




The shrimps for local consumption are products from the municipal and the commercial fishery sector while the shrimps which are exported come entirely from aquaculture. The percentage distribution of shrimp and production performances by sector from 1992 to 1997 is provided in Figure 1 and Table 2.

## PHILIPPINE MARINE JURISDICTIONAL BOUNDARIES

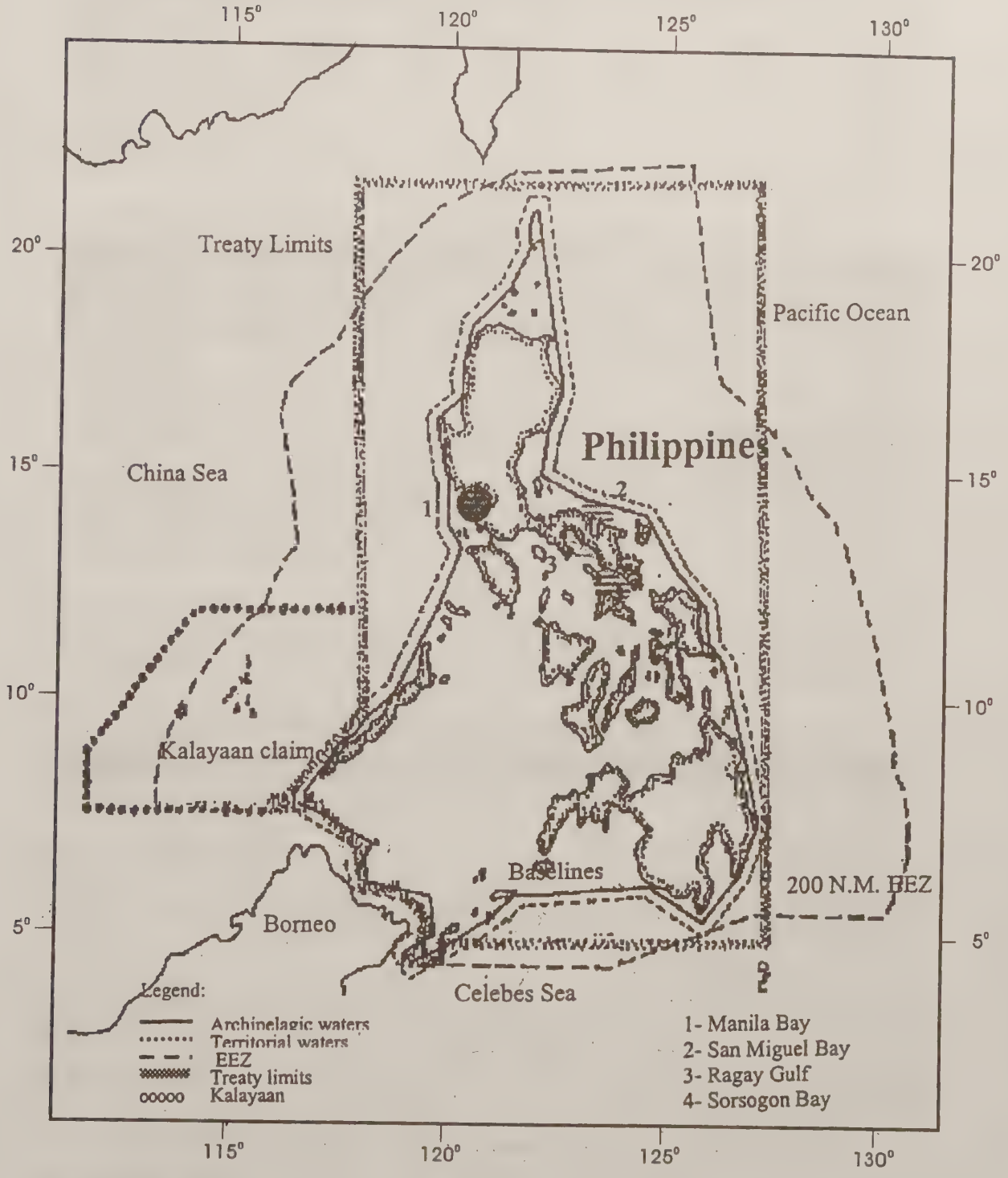



**Figure 2.** **Map of the Philippines showing the limits of archipelagic, Territorial Waters treaty limits, Exclusive Economic Zone (200 N.M. E.E.Z.) and Figure 2. Kalayaan Claim. It also shows the location of Manila Bay, San Miguel Bay, Ragay Gulf and Sorsogon Bay**

**TABLE 2. Shrimp Production by Sector (1992-1997) in MT**

| Sector | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|
| Aquaculture | 78,386 | 95,816 | 92,647 | 89,196 | 78,067 | 41,454 |
| Municipal fisheries | 43,880 | 27,810 | 26,497 | 32,068 | 31,100 | 25,334 |
| Commercial fisheries | 4,997 | 9,860 | 9,153 | 9,027 | 8,741 | 7,156 |
| **Total** | 127,273 | 133,486 | 128,297 | 130,291 | 117,908 | 73,994 |

Tables 3 and 4 present shrimp production and relative abundance by species in marine capture fisheries.

**TABLE 3. Municipal Shrimp Production by species (1992-1996) in MT**

| Species | 1992 | 1993 | 1994 | 1995 | 1996 | % |
|---|---|---|---|---|---|---|
| ***I. Inland*** | | | | | | |
| Freshwater shrimp | 8,474 | 1,249 | 1,439 | 3,606 | 3,971 | 75 |
| Freshwater lobster | 6 | 2,025 | 281 | 422 | 711 | 13.8 |
| White shrimp | | | 1,216 | 431 | 360 | 4.4 |
| Endeavor prawn | | | 192 | 237 | 225 | 4.4 |
| *Acetes* | | 77 | 11 | 39 | 24 | 0.7 |
| Total Inland | 8,480 | 3,351 | 3,139 | 4,735 | 5,291 | (16) |
| ***II. Marine*** | | | | | | |
| White shrimp | 13,085 | 12,756 | 10,144 | 9,856 | 9,108 | 40.3 |
| *Acetes* | 16,209 | 6,241 | 6,432 | 8,966 | 8,657 | 34.0 |
| Endeavor prawn | 4,268 | 3,110 | 4,794 | 5,672 | 5,179 | 16.9 |
| Brown rough shrimp | 910 | 946 | 1,059 | 1,680 | 1,739 | 4.6 |
| Tiger prawn | 928 | 1,406 | 929 | 1,159 | 1,126 | 4.1 |
| Total Marine | 35,400 | 24,459 | 23,358 | 27,333 | 25,809 | (84) |
| **Total Municipal** | 43,880 | 27,810 | 26,497 | 32,068 | 31,100 | (100) |

**TABLE 4. Commercial Shrimp Production by species (1992 to 1996) in MT**

| Species | 1992 | 1993 | 1994 | 1995 | 1996 | % |
|---|---|---|---|---|---|---|
| *Acetes* | 4,003 | 8,992 | 8,292 | 8,232 | 8,144 | 90.0 |
| Endeavor prawn | 427 | 387 | 341 | 382 | 252 | 4.3 |
| White shrimp | 294 | 435 | 486 | 288 | 220 | 4.1 |
| Brown rough shrimp | 229 | 35 | 26 | 119 | 117 | 1.3 |
| Tiger prawn | 44 | 11 | 8 | 6 | 8 | 0.2 |
| **Total Commercial** | 4,997 | 9,860 | 9,153 | 9,027 | 8,741 | 100.0 |

### 3.2 Production Methods

In addition to trawling, 11 fishing methods are known as exploiting, directly and indirectly, shrimp resources in municipal waters and 5 methods in commercial sector. For small-scale and large-scale shrimp fisheries in both municipal and commercial waters, the majority of the captures come from pushnets and trawls (Table 5 and 6).

**TABLE 5. Municipal Shrimp Production (in MT) by Fishing Gear, 1995**

| Fishing Gear | White Shrimp | Acetes | Endeavor Prawn | Brown rough shrimp | Tiger Prawn | Total | % |
|---|---|---|---|---|---|---|---|
| 1. Pushnet | 2,144 | 3,930 | 807 | 19 | 42 | 6,942 | 25.76 |
| 2. Baby trawl | 1,110 | 672 | 1,443 | 1,025 | 621 | 4,871 | 18.08 |
| 3. Fyke net | 7 | 3,065 | | | | 3,072 | 11.40 |
| 4. Gill net | 1,963 | 55 | 437 | 264 | 88 | 2,807 | 10.42 |
| 5. Fish corral | 1,496 | 19 | 737 | 299 | 89 | 2,640 | 9.80 |
| 6. Beach seine | 1,435 | 941 | 50 | 1 | 89 | 2,516 | 9.34 |

| Fishing Gear | White Shrimp | Acetes | Endeavor Prawn | Brown rough shrimp | Tiger Prawn | Total | % |
|---|---|---|---|---|---|---|---|
| 7. Filter net | 475 | 1 | 1,658 | 58 | 176 | 2,368 | 8.79 |
| 8. Fish pot | 296 | | 96 | 2 | 2 | 396 | 1.47 |
| 9. Cast net | 192 | | 6 | | 9 | 207 | 0.77 |
| 10. Danish seine | 76 | | 47 | | 5 | 128 | 0.48 |
| 11. Ring net | 113 | | | | | 113 | 0.42 |
| 12. Lift net | 53 | 3 | | 1 | 2 | 59 | 0.22 |
| 13. Others | 496 | 280 | 391 | 11 | 36 | 1,214 | 4.51 |
| Total | 9,856 | 8,966 | 5,672 | 1,680 | 1,159 | 27,333 | 100.00 |

**TABLE 6. Commercial Shrimp Production (in MT) by Fishing Gear, 1995**

| Fishing Gear | Acetes | Endeavor Prawn | White Shrimp | Brown rough shrimp | Tiger Prawn | Total | % |
|---|---|---|---|---|---|---|---|
| 1. Pushnet | 6,745 | 41 | 59 | | | 6,845 | 75.83 |
| 2. Trawl | 942 | 232 | 156 | 50 | 6 | 1,386 | 15.35 |
| 3. Beach seine | 529 | 1 | 2 | | | 532 | 5.89 |
| 4. Purse seine | . | 106 | 33 | 68 | | 207 | 2.29 |
| 5. Gillnet | 14 | 1 | 33 | | | 48 | 0.53 |
| 6. Others | 2 | 1 | 5 | 1 | | 9 | 0.10 |
| Total | 8,232 | 382 | 288 | 119 | 6 | 9,027 | 100.00 |

### 3.3 Fishing Grounds (Figure 2)

### A. Description

### A.1 Sorsogon Bay

Sorsogon Bay is a shallow inlet with an area of 256 km$^2$ located at the southern tip of Luzon Island. It is bounded by longitude 123°50'E and 124°10'E and latitude 12°59'N. The bottom of the Bay consists of muddy flat bottom ranging from 0.5 to 9 m in depth with an average 4.4 m. The deepest portions are from 10 to 29 m deep with few coral reef fringes. Wet climate prevails throughout the year and highly pronounced from months of November to January.

### A.2 San Miguel Bay

San Miguel Bay is located in the southeastern part of Luzon Island covering an area of 1,152 km$^2$. The bay features a very shallow area at the inner and central portion (3 to 10 m) of the coasts that gradually deepens at the outer canal leading to the Pacific Ocean (31 m deep). Mudflats comprise 95% of the substrate cover with few rocky and coral fringes near the mouth of the Bay. The bay is an estuary where freshwater inflow from major river tributaries significantly dilutes seawater. These waters with mixed origin have higher temperatures, thus possess high-biological production.

The climate in San Miguel Bay is characterized by no dry season and heavy rainfall from November to January. The northeast monsoon from November to March brings extremely strong winds while the south monsoon (June to October) has little or no effect.

### A.3 Ragay Gulf

Ragay Gulf is located in the southwestern part of the Luzon Island in the Philippines. It is bounded on the west and north by the province of Quezon and on the northeastern and east by the province of Camarines Sur; it is demarcated at the south by an imaginary line that crosses eastward for 122°40'75" E, 13°19'4" N to 123°13'72" E, 13°19'4" N. The Gulf covers approximately 3,912 km$^2$ and characterized by narrow shelf and deep waters up to 600 m depth. Shelf areas along the Gulf are predominantly smooth and muddy. There are also coral reef areas along the coast, in particular along the southern portion of the Bondoc Peninsula.

### A.4 Manila Bay

Manila Bay is a semi-enclosed body of water bounded by the shoreline of Cavite, Metro Manila, Bulacan, Pampanga and Bataan. It covers a total area of 1,782 $km^2$ with a length of 60 km, a varying width from 22 km at its mouth to 60 km at its widest portions, and is located roughly between latitudes $14^0$15' and $14^0$ 50' North and longitudes $120^0$ 30' and $121^0$ 00' East. The bay is relatively shallow with an average depth of almost 19 m. 80% of the bay area is less than 30 m deep.

Manila Bay's climate is characterized by two pronounced seasons: dry from November to May and wet from June to September. The northeast monsoon dominates from October to February while, from March to May, the Southeast Trade Winds occur. The southwest monsoon prevails from June to September (FSP-REA Manila Bay).

## B. Production

### B.1 Sorsogon Bay

Sorsogon Bay is essentially a municipal fishing area where for the period 1992-1995, production was estimated to have an annual average of 5,300 MT (BAS, 1995) of which an average of about 12% was supplied by baby trawl (Table 7).

For 1996, the landing was estimated to be around 5,818 MT, almost 5% of which had been caught by "mini-trawls" (Cinco *et. al.*). The main other gears in terms of production are gillnets, "modified Danish seine", fish corral and crab gillnet.

**TABLE 7. Contribution of Baby trawl to the Total Marine Municipal Catch from 1992-1995 in Sorsogon Bay**

| Year | Baby Trawl (MT) | Marine Municipal Landing (MT) | Percent (%) contribution of Baby Trawl |
|---|---|---|---|
| 1992 | 444 | 3,522 | 12.6 |
| 1993 | 425 | 3,208 | 13.2 |
| 1994 | 420 | 6,848 | 6.1 |
| 1995 | 1,333 | 7,625 | 17.5 |
| Total | 2,622 | 21,203 | 12.4 |
| Average | 655.5 | 5,300.75 | 12.4 |

Source: BAS.

Typical trawlers found in the area were traditionally of small-scale type. In 1972, BFAR reported 24 mini-trawlers in operation. There was a sudden increase in 1993 to about 155 units (PRIMEX, 1993). In 1994, a municipal ordinance banning trawl operations ceased its further expansion, thus, reducing the number of small trawlers one year later to only 36. Despite the ban, few trawling operations still persist at night time.

The trawls commonly used are two-seam, low-opening, trawl made from polyethylene (PE). The headrope and groundrope length are 3.5 m and 4 m, respectively. The mesh size of the codend is normally about 1.7 cm. The wings of the net are connected to two rectangular otter boards, 0.5 m per 0.75 m in size. Typically, 6 m "bancas, with 10-16 HP gasoline engine, äre used to tow the trawl net.

According to a survey from April 1994 to January 1995, the catch per unit effort would be, for a 16 HP mini-trawler, 6.6 kg/hr (with trawling speed being 2 knots). The cardinalfishes, Portunid crabs, slipmouths, flatfishes and gobies were the main species (64% of the total). Penaeid shrimp accounted for 3.5% only.

For the same type of small trawler, in 1999 (May to August; on a total of 100 drag observations or 200 fishing hours), the average catch rate was found being 7.5 kg/hr. The composition of the catch revealed that species which are normally discarded such as crablets, seamantis and sea cucumber are an average

of 44% of the total catch. Low-valued but marketable miscellaneous species, majority of which are gobies (26%), accounted for 33%. Shrimps shared a high-catch rate of 23%. In order of importance in the catch, the shrimp species consisted in: brown rough shrimp, white, endeavor and tiger shrimp (Table 8).

### B.2 San Miguel Bay

For the period 1992-1995, the average municipal production was about 11,103 MT in the San Miguel Bay, with baby trawl contributing 9.2%. (Table 9). The main fishing gears are gillnets and trawls and medium and large trawlers, normally operating in the commercial sector are also found in the Bay. Several assessments indicate that the fishery resources in the Bay are heavily exploited or, even, over-fished with catch rates significantly declining (BFAR-FSP, REA SMB).

**TABLE 8. Composition of Trawl Catch (May to August, 1999) in Sorsogon Bay**

| Group | Total | % |
|---|---|---|
| **Target catch** | 346.3 | **23.0** |
| Brown rough shrimp | 169.3 | 11.3 |
| White shrimp | 121.0 | 8.1 |
| Endeavor shrimp | 54.25 | 3.6 |
| Tiger shrimp | 1.75 | 0.1 |
| **Marketable By-catch** | 490.0 | **33.0** |
| Goby | 384.7 | 26.0 |
| Blue-swimming crabs | 40.9 | 2.7 |
| Slipmouth | 19.7 | 1.3 |
| Goatfish | 13.1 | 0.9 |
| Whiting | 9.85 | 0.7 |
| Eel | 6.25 | 0.4 |
| Glassfish | 4.25 | 0.3 |
| Whipfin mojarra | 2.75 | 0.2 |
| Spotted flatheads | 1.35 | 0.1 |
| Octopus | 5.5 | 0.4 |
| Squid | 1.5 | 0.1 |
| **Discards/Thrown away catch** | | |
| Crablets, seamantis & sea cucumber | 657.9 | **44.0** |
| TOTAL | 1,494. | 100.0 |

**TABLE 9. Contribution of Baby trawl to the Total Marine Municipal Catch from 1992-1995 in San Miguel Bay**

| Year | Baby Trawl (MT) | Marine Municipal Landing (MT) | Percent (%) contribution of Baby Trawl |
|---|---|---|---|
| 1992 | 1,284 | 11,255 | 11.4 |
| 1993 | 987 | 11,070 | 8.9 |
| 1994 | 906 | 10,968 | 8.2 |
| 1995 | 938 | 11,121 | 8.4 |
| Average | 1,028.75 | 11,103.5 | 9.2 |

Source: BAS.

### *B.2.1 Municipal Trawl Fleet*

The small-sized trawl fleets can be divided into two groups: baby trawlers (2-3 GT) and mini-trawlers (2 GT or less). The size of the fleet has shown a large expansion from 1982 to now as shown in Table 10, almost multiplied by two. As a whole, the municipal trawling sector contributed an average of 9% of the total marine municipal landings.

A ten (10) month resource survey was conducted from September 1992 to July 1993 (under the Resource and Ecological Assessment San Miguel Bay Programme) with a trawl operated by a 10 m length boat powered by 65 HP inboard engine. The mean catch rate was 32.3 kg per hour, being highest in October 1992, at 73.9 kg/hr, and lowest in April 1993, at 13.4 kg/hr. Slipmouths (*Leiognathidae*) composed over a third (37.6%) of the catch, and together with croakers (*Sciaenidae*), anchovies (*Engraulidae*), hairtails (*Trichiuridae*) and shrimps (*Penaeidae*), comprised over two-thirds (67.4%) of the catch during that period. The results of the survey indicated heavy fishing pressure on the resources of San Miguel Bay. Symptoms of all forms of biological over-fishing were reported.

**TABLE 10. Trawl fleet characteristics and sizes in San Miguel Bay**

| Trawl type | Sector | Length (m) | Engine (hp) | # Units (Vakily 1982) | # Units REA (1992) | # Units DA-BFAR (1992) | # Units Rapid Assessment (1999) |
|---|---|---|---|---|---|---|---|
| Medium | Commercial | 19-25 | 250-500 | 30 | 1 | 35 | - |
| Small | Commercial | 18 | 150-220 | 17 | 4 | 38 | 20 |
| Baby trawl | Municipal | 11 | 60-90 | 72 | 50 | - | 33 |
| Mini trawl | Municipal | 7 | 10-16 | 188 | 260 | - | 569 |

A catch assessment was also carried out for the months of April, June and August 1999. Day and night time fishing operations were concentrated in the inner parts of the Bay. The tow duration was around two hours at day time and four hours at night. The total catch per unit effort was 4 kg/hr. Shrimp was 15% of the total, other invertebrates (dominated by crabs) 40%, mixted big fish, 20% and trash fish (including small-sized invertebrates such as starfish, seamantis and young/small fish, less than 10 cm in length) accounted 25%.

### *B.2.2 Commercial Trawl Fleet*

After a resolution was called for non allowed entry of commercial fishing vessels in San Miguel Bay, large commercial trawlers have shifted to other fishing grounds (e.g., Lamon Bay). Other units are still operating despite regulations on commercial fishing inside the Bay.

## B.3 Ragay Gulf

Similar to other bays and near shore marine areas, Ragay Gulf is essentially characterized by municipal fishery activities. Municipal and Commercial production data sourced from the Gulf are shown in Tables 11 and 12. From 1992-1995 data, the total marine municipal landing depreciated together with the declining production from the municipal trawling sector. The average municipal fisheries production was for the period nearly 12,000 MT of which 9% was caught by baby trawl. The commercial fisheries production was less, an average of 8,200 MT, with 4.3% from trawling.

Trawling operations were, in this period, conducted year round in shallow inner sector of the Gulf with depths ranging from 40 to 70 m by two types of fleets: municipal and commercial trawl fleets.

The municipal trawl fleet, around 105 units, typically used low-opening bottom otter trawls. Hauls were made twice a day with towing duration of 6 hours. No historical data was available to compare the catch per unit effort of this small-scale trawl gear.

**TABLE 11. Contribution of Baby trawl to the Total Marine Municipal Catch from 1992-1995 in Ragay Gulf**

| Year | Baby Trawl (MT) | Marine Municipal Landing (MT) | Percent (%) contribution of Baby Trawl |
|---|---|---|---|
| 1992 | 3,444 | 13,816 | 24.9 |
| 1993 | 780 | 16,598 | 4.7 |
| 1994 | 306 | 10,479 | 2.9 |
| 1995 | 270 | 6,024 | 4.5 |

Source: BAS.

**TABLE 12. Contribution of Trawl Catch to the Total Commercial Production from 1992-1995 in Ragay Gulf**

| Year | Commercial Trawl (MT) | Commercial Landing (MT) | Percent (%) contribution of Trawl |
|---|---|---|---|
| 1992 | 417 | 4,118 | 10.1 |
| 1993 | 271 | 8,161 | 3.3 |
| 1994 | 383 | 13,976 | 2.7 |
| 1995 | - | 6,786 | - |

Source: BAS.

The performances of a typical municipal shrimp trawler, 10 m long with 90 HP engine were assessed from February to August 1999. The recorded catch per unit effort was 3.2 kg per hour of tow (Table 13). The main shrimp species caught were the white shrimp (*Penaeus merguiensis*) and tiger shrimp (*P. semisulcatus*) which accounted 20% of the total. By-catches were dominantly composed of threadfin breams (*Nemipterus* spp.), goatfishes and barracuda. Low valued small fishes were used for making a fish meal while in undersized invertebrates and non-consumable fishes with little or no commercial value were discarded (Table 14).

The commercial trawl fleets, on the other hand, about 17 units, used high opening bottom otter trawl, also referred to as "*norway trawl*" towed at relatively high speed, thus, making the catch of pelagic species possible. The average catch per unit effort was 127 kg per hour of tow. Day time fishing was commonly practiced with tow duration of 2 hours per haul with peak operations in April and May. The mesh size in the codend is usually 2 cm. The dominant species caught by "*norway trawl*" were *Sardinella longiceps* and *S. fimbriata* accounting 35 and 15% of the catch, respectively. It is worth mentioning that the commercial trawl fisheries experienced problems regarding the Territorial Use Rights Fisheries (TURF).

**TABLE 13. Monthly catch per unit effort of boarded shrimp trawl in Ragay Gulf**

| Month (1999) | CPUE (kg/hr) | Fishing hrs. |
|---|---|---|
| February | 3. | 36 |
| March | 3.4 | 36 |
| April | - | - |
| May | 3.9 | 36 |
| June | 2.9 | 36 |
| July | 3.5 | 72 |
| August | 2.7 | 72 |
| **Average** | 3.2 | |

### B.4 Manila Bay

Contibution of baby trawl and commercial trawl sectors to the Total Fish Production are shown in Tables 15 and 16. The performances of the commercial trawlers make that their contribution to the total production is more than the municipal trwaling sector. From 1992 to 1995, the trend of capture is not so clear for the commercial trawling sector but the municipal production showed a clear declining trend.

**TABLE 14. Catch categorization by Total Relative Abundance (%)**

| Month (1999) | Shrimp | By-catch | Fish meal | Discard | % |
|---|---|---|---|---|---|
| February | 28. | 46. | 19. | 7. | 100 |
| March | 23. | 44. | 20. | 13. | 100 |
| May | 14. | 55. | 15. | 16. | 100 |
| June | 20. | 54. | 9. | 17. | 100 |
| July | 16. | 61. | 8. | 15. | 100 |
| August | 17. | 55. | 10. | 18. | 100 |
| **Average** | 20. | 52.5 | 13.5 | 14. | 100 |

**TABLE 15. Contribution of Baby trawl to the Total Marine Municipal Catch from 1992-1995 in Manila Bay**

| Year | Baby Trawl (MT) | Marine Municipal Landing (MT) | Percent (%) contribution of Baby Trawl |
|---|---|---|---|
| 1992 | 2222 | 17598 | 12.6 |
| 1993 | 1721 | 13245 | 13.0 |
| 1994 | 1341 | 12750 | 10.5 |
| 1995 | 1525 | 11652 | 13.1 |
| **Average** | 1702.25 | 13811.25 | 12.3 |

Source: BAS.

**TABLE 16. Contribution of Trawl Catch to the Total Commercial Production from 1992-1995 in Manila Bay**

| Year | Commercial Trawl (MT) | Commercial Landing (MT) | Percent (%) contribution of Trawl |
|---|---|---|---|
| 1992 | 5,036 | 15,587 | 32.3 |
| 1993 | 10,105 | 20,740 | 48.7 |
| 1994 | 10,196 | 26,222 | 38.8 |
| 1995 | 9,859 | 25,046 | 39.3 |
| **Average** | 8,799 | 17,519 | 50.2 |

Source: BAS.

#### *B.4.1 Municipal Trawl sector*

There Resource and Ecological Assessment Programme in Manila Bay found around 346 baby trawling units in 1992/1993. The standing biomass was assessed through a trawl survey using a 13.5 m trawler. The catch per unit effort had found an average of 10 kg per hour. The mean CPUE was highest in September to October, 13.8 kg/hr and lowest in March to April, 5.2 kg/hr. Historical data show (Table 17) large fluctuation of the CPUE from 1947, with a clear decreasing trend from 1970: 61.8 kg/hr in 1970 to 14.0 kg/hr in 1986.

**TABLE 17. Historical Information from different Trawl Surveys in Manila Bay**

| Year | CPUE (kg/hr) | Composition | |
|---|---|---|---|
| | | Fish | Invertebrates |
| 1947 | 44.0 | | |
| 1948 | 45.8 | | |
| 1957 | 16.2 | | |
| 1958 | 13.3 | 81 | 19 |
| 1959 | 12.2 | | |
| 1960 | 15.7 | 96 | 4 |
| 1961 | 13.6 | | |
| 1962 | 16.3 | 91 | 8 |
| 1966 | 14.0 | | |
| 1970 | 61.8 | | |
| 1971 | 37.4 | | |
| 1980 | | 79 | 21 |
| 1983 | 27.9 | 80 | 20 |
| 1986 | 14.0 | 36 | 64 |
| 1993 | 10.0 | 75 | 25 |
| *1996 | 10.4 | 41 | 59 |

Source: 1947 - 1986 Data BFAR. * on board survey (5 months).

Another survey was conducted from August to December 1996 with a baby trawling unit (11 m in length and 80 HP engine). The results indicated a similar catching efficiency of 10.4 kg/hr (Table 18) with invertebrates being dominant in the catches (Table 19).

### *B.4.2 Commercial Trawl Sector*

In 1997 the number of commercial trawling units licensed for the Manila Bay was as follows: 159 "small-commercial" units and 67 "medium commercial" one. The medium-commercial vessels continued their operation beyond the Manila Bay, along vicinities of Zambales, Subic Bay and Palawan waters while a few small-commercial vessels normally operating in the middle-portion of the Bay, encroach on municipal waters.

**TABLE 18. Monthly catch per unit effort of a baby trawling unit in 1996 in Manila Bay**

| Month | CPUE (kg/hr) | Fishing hours |
|---|---|---|
| August | 7.4 | 10 |
| September | 8.8 | 8 |
| October | 19.6 | 9 |
| November | 8.0 | 10 |
| December | 8.3 | 10 |
| **Average** | 10.4 | 9.4 |

**TABLE 19. Catch composition of a baby trawling unit in 1996 in the Manila Bay in Relative Abundance (%)**

| Month | INVERTEBRATES | | | | Big Fish | Small-Fish | Trash fish | % |
|---|---|---|---|---|---|---|---|---|
| | Shrimp | Edible Crusta-Ceans | Inedible Crusta-ceans | Cepha-lopods | | | | |
| August | 10. | 28. | 27. | 2. | 8. | 6. | 18. | 100 |
| September | 5. | 36. | 23. | 2. | 11. | 3. | 20. | 100 |
| October | 11 | 10. | 16. | 5. | 8. | 2. | 48. | 100 |
| November | 10. | 19. | 25. | 6. | 10. | 20. | 10. | 100 |
| December | 16. | 6. | 34. | 5. | 6. | 19. | 14. | 100 |
| **Average** | 10. | 20. | 25. | 4. | 9. | 10. | 22. | 100 |

## C. Socio-economic Role of Trawl Fishery

### C.1 Competition

The trawl fisheries are acknowledged to have contributed significantly to the country's increased fish production since its introduction in the 1940s. Even with the present assertion that trawl has contributed to resource depletion and environmental degradation, trawling is still a major fishing method.

Considering its contribution to production, trawl fishing is very important: Around 9% of the total production in some commercail areas such as Ragay and San Miguel, 12% in Sorsogon and Manila Bays; even higher in the municipal waters. In addition, trawling is employing a lot of fishermen.

In general, the fishing technology to be used is required allowing the catch of demersal species on e flat and muddy bottom. While trawl fishing is the most common fishing method, in general, other fishing gears are also catching shrimp: Some are specifically designed for shrimp such as shrimp gillnet, other are catching shrimp in addition to other species e.g. pushnet, seine net, lift net and stationary trap such as fish corral, fyke net, filter net, etc. The rate of capture and the catch composition depend on the type of gear and the mode of operation, but, in general, the shrimp is a minor part of the catch. *Penaeid* shrimp species have normally sparse distribution and often caught only at night. The large shrimp are, in general, exploited, in deeper waters, offshore while other shrimp resources, small species such as *Acetes* are tapped in more dense concentration and seasonally (during the southwest monsoon) in the inner portions of the bays. It is worth mentioning that, in general, young shrimps are more common in shallow coastal areas where stationary gears are installed.

In the bay two categories of fishing operators are met: - municipal or small-scale fishermen and - commercial or industrial fishermen. The use of bigger boats and better fishing make that commercial operators are very effective, placing the municipal fishermen in a difficult position to compete when on the same fishing grounds. Some small-scale fishermen groups facing great difficulties resort to illegal forms of fishing such as dynamite and cyanide, to ultimately get some income.

The stiff competition among users and harmful fishing practices resulted in an overall decrease in fish catch a decrease in the catch of adult fishes and an increase catch of juveniles; high mortality of fishes; increasing portion of invertebrates; destruction of coral reef and bottom communities; decrease water transparency; etc. If this situation continues, the marine productivity in a number of bays will further be lowered.

The depleted state of marine resources and the increasing population in the coastal communities of San Miguel Bay resulted in increased competition and intensified conflict between and among user groups. The encroachment of trawlers into prohibited zones, despite existing fisheries laws and regulations, resulted in uneven catch and income for small-scale and subsistance fisheries in the bay.

Some small fishers were left with no choice but to use illegal and destructive fishing methods to meet the needs of their families.

### C.2 Several aspects

The lack of employment opportunities and alternatives to supplement low household incomes greatly contributed to increased fishing effort in the bay.

Twelve villages bordering the San Miguel Bay were surveyed. A sample of of 536 fishing households was selected from 1993 census out of 1, 341 householdswere selected.

The data from the sample survey indicate a wide variation in the nature of fishing activities in the 12 villages. In the smaller villages, owner-operators (full and part owners) outnumber fishermen.

The nature of fishing activities also tends to vary with the age of the respondent. Owner-operators (notably full-owners) tend to be concentrated in the upper age brackets and non-owners operators (fishermen) in the lower age brackets. This pattern can be explained by the fact that many young fishers have not yet accumulated sufficient capital to own a boat and gear.

A total of 94% of the respondents were married and had wives living with them in the household. The respondents had an average of 4.2 children, of whom an average of 3.3 were living in the household. Among the people documented in the survey, almost half (46%) were 20 years old or less. Seventy nine percent had gone through sixth grade or above. Nine percent had gone through high school or beyond. Only one of the respondents had no education at all. Females tend to have slightly more education than males. Fifty-two percent of females and 50% of males had a sixth grade education or above.

In 1980-1981, there were over 3,500 units of fishing gear being used in San Miguel Bay. Forty two percent are gillnetters, about 18% are scissor net, 12% hook and line, and the remaining are mini trawl, stationary liftnet, fishpot, longline, fish corral, crab liftnet, filternets, spearguns, beachseine, fish weir, round hand seine, cast net, etc. Gillnetters and trawlers operate year round catching the bulk of the Bay's total catch. The majority of gillnetters and trawlers are based in the three municipalities of Cabusas, Calabanga and Tinambac. Although the whole year is considered productive, the southeast monsoon (habagat) favors the operation of gillnetters while the northeast monsoon (amihan) favors the operation of mini trawlers. From October to June, *Acetes* (sergestid shrimp) are the predominant species landed in Castillo. From June to October, mini trawlers catches decline in volume as many of the operators modify their net increasing the mesg size for catching bigger shrimps.

Before mini-trawlers appeared in San Miguel Bay, fishermen stated that daily catches of pushnets could reach 50 kg or more. But catches declined after the introduction of mini-trawlers. The pushnets are normally used for three months June to August only and catch consists mostly of *Acetes* (sergestid shrimp) with occasional larger shrimps. The fishermen are part time seasonal fishermen supplementing their household income.

Mini trawlers are the smallest trawlers in San Miguel Bay: an average of 10.5 m long, 0.9 m wide and 16HP gasoline engines. Unlike the gillnetters, the mini trawlers have no outriggers. Trawling speed is very slow estimated to be 1 knot and manned usually by a crew of two. It uses two types of net which have the same body but differ in mesh size and material in the codend: either with fine meshed screen or bigger one (17 knots nylon). Specific nets for *Acetes* (sergestid shrimp) are used from September to June while the shrimp trawls are preferred from July to August. A typical fishing trip for a mini trawler lasts only one day.

In San Miguel Bay, according to a survey in November 1999, shrimp resources are exploited by baby trawl (koto-koto) and gillnets. The baby trawlers and gillnetters are wooden "banca"with an outrigger and with or without engine. 10 to 16 HP engines are usually common. The average length of a traditional "banca" is 7 m, width and depth, 0.6 and 0.7 m respectively.

Trawling banca measuring 9 m and above overall length have engine from 60 to 80 HP. The trawlers operate throughout the year with average maximum catch of 40 kg per day during peak season from September to March when the water is turbid due to the northeast monsoon. During lean season (April to October), the average catch per day is 20 kg. The catch composition consists, as a rough, general estimate, in shrimp amounting 15%, crabs 40%, assorted fish 20%, and trash fish 25%. The bancas using shrimp gillnets, smaller and with less powerful engine, operate from November to march and from May to September. The duration of operations vary from 4-12 hours daily and the average catch ranges from 5-10 kg per day. Shrimps are about 10% of the total catch, crabs 20%, assorted fish 65%, and trash ·ish 5%.

Both types of operation employ one or two fishermen per banca. As for the revenues, the sharing schemes are of two types: – Either the operating expenses are deducted from the total sales and the net income will be divided into two equal parts for the two fishermen; - or, the net income is divided into three parts, one share goes to the banca, one to the owner, and one to the fishermen. Shrimp catches upon landing are handled by the brokers who bring the catch to Manila for local distribution to the wet/fresh fish market, restaurants and hotels.

## 4. REGULATIONS AND MANAGEMENT MEASURES

In the 1980's, the decrease of the profits caused by the lower level of productivity, the increase of the costs of operations and more competition between multiple fishery, prompted the establishment of some management restrictions for trawl fisheries.

Regarding commercial trawl fisheries, the regulation consists in - closed seasons for areas which are known as being overfished (Fisheries Administrative Order (FAO) Numbers 130; 131; 132; 134; 136; 137 and 142); and - designation of fishing zones (i.e., prohibition of fishing within 7 km distance from shore (Letter of Instruction (LOI) 1296; Presidential Decree (PD 281) and within 7 fathoms deep (Republic Act 3048); in 1983, Letter of Instruction No. 1328 was promulgated to close commercial trawl fishing within 7 km from the shoreline and within 7 fathoms deep on a nationwide basis).

The most recent legal decision was Republic Act # 8550 (1998), also known as The Philippine Fisheries Code, closing the bays, gulfs, and other inland waters for vessels utilizing active fishing gears such as trawl.

**FAO 156** provides guidelines and procedures in the effective implementation of the above mentioned Letter of Instruction No. 1328 prohibiting commercial trawl fishing within 7 km from the shoreline and within 7 fathoms deep in the whole country. There is an urgent need to improve the standard of living in the rural fishing communities of the country. The prohibition of commercial trawling, but also, commercail purse seining in coastal waters provides municipal and small scale fishermen with a wider area within which to operate fishing boats of three (3) GT or less, and with opportunities for increasing their catch per unit effort.

Other legal texts concern specific aspects of commercialisation of shrimps, for instance, - The exportation of live pond-raised prawns (except the fry, fingerlings, and spawners) is authorized provided that the individual weight of it is no more than 60 grams or - The prohibition on the importation of live shrimp and prawn of all stages.

## 4.1 Previous/Existing Regulations/Policies Affecting the Shrimp Resource

### *4.1.1 National Fishing Ordinances*

Mesh size regulation. Except for capturing Penaiedae for pound-cultture ("sugpo fry" () and small but relatively matured species such as *Acetes* (alamang), a Fisheries Admnistrative Order (FAO) No. 155 (1986) prohibits the use of fishing gears with fine mesh nets.

Seasonal closure. Prior to the enactment of R.A. 7160, otherwise known as the Local Government Code of 1991, several national fishery administrative orders were issued to close trawl operation in some parts of the country (se list below).

Regulation of trawl operation in Maqueda, Villareal and Carigara Bays, inlcuding Zumarraga Channel (FAO 37, s. 1954, as amended up to 73-2 superseded); Manila Bay (FAO 54, s. 1959 superseded; FAO 99, s. 1970 superseded; FAO 175, s. 1991); Cancabatoc, City of Tacloban (FAO 58 s. 1959); northern and northwestern waters of Bohol for 5 years period (FAO 62, s. 1960 expired); prohibition of trawl fishing in Bohol for a period of one year (FAO 104, s. 1971 expired); 5 year closed season for operation of trawl in Bohol (FAO 130, s. 1981 expired); closed season for trawl operation in Negros Oriental (FAO 132, s. 1981 superseded); closed season of 5 years for commercial trawl in waters of Quezon province (FAO 134, s. 1981 expired/superseded); closed season of 5 years in waters of Palawan (FAO 137, s. 1982 expired/superseded); closed season of 5 years for operation of trawl in waters of Batangas (FAO 142, s. 1983-expired);

Import and Export Regulation of Live Shrimps/Prawn

Ban on exportation of live gravid shrimps of genus *Penaeus* (FAO 141, s. 1982-amended by FAO 143); ban in exportation of live prawns (sugpo) of the species *Penaeus monodon* (FAO 143, s. 1983); the above mentioned texts regarding the exportation of live pond-raised prawns not more than 60 g per piece (FAO 143-5, s. 1983 subsisting) or the prohibition of the importation of live shrimp and prawn of all stages (FAO 189, s. 1993).

### *4.1.2 Municipal Fishing Ordinances*

As the enforcement of fishery laws in the municipal waters has been devolved to the Municipal Government pursuant to section 17 R.A. 7160, specific fishery measures are now formulated and

enforced by the local government. Concerning shrimp fisheries, the most common regulation consists in the banning of trawl fishing operations in their jurisdictional waters.

Regularly monitored shrimp trawl fishing grounds has promulgated measures as follows:

San Miguel Bay

Some municipalities among the seven in the Bay area, may allow operation of baby trawls (less than 3 gross tonnes) but only beyond 7 km from the coastline (Municipality of Calabanga, Province of Camarines Sur as per M.O. 95-06); other, such as Mercedes, prohibit trawling within 15 km from the coastline (M.O. 65-95). However, it is worth mentioning that capturing sugpo fry for pond rearing is authorized everywhere.

Ragay Gulf

There are 8 municipalites in the area. Trawling activities can be metin two municipalities only. The use of motorized pushnet is prohibited by certain municipalities while other limits commercial trawl operations. One of the municipalities prohibits the use of fishing gears with less than 3 cm mesh size.

Sorsogon Bay

One municipality out of six, only, (Sorsogon) authorizes baby trawl fishing. In general, authorized grounds for trawling are beyond 15 km from the coastline.

## 5. RESEARCH ACTIVITIES, PAST AND FUTURE

According to Villadolid and Villaluz (1951) *Penaeus monodon* is caught in the open sea in trawls, with other shrimp species but always outnumbered by the other species. *P. monodon*, is also commonly found throughout coastal areas, tidal rivers and estuaries. Several Penaeidae occur abundantly in mangrove swamps.

In the Manila Bay area, the bulk of the *Penaeus monodon* fry for aquaculture comes from the Cavite side of the Bay (especially from the towns of Ternate and Naic). Other important sugpo fry grounds are Bauan and Balayan in Batangas, Bulacan, Pampanga, Dasol Bay in Pangasinan, the Ilocos Provinces, San Jose in Occidental Mindoro, Quezon province, Paracale in Camarines Norte, Capiz, Carigara in Leyte, Maqueda Bay in Samar, Guimaras in Iloilo, Panguil Bay in Ozamis City, Cotabato, Cagayan de Oro area and Sibuguey Bay.

Small brackishwater shrimps called *Acetes* (Alamang) are fished in most parts of the country when winds blow towards the land. Another variety of small shrimp known as "Atya" is found in Lake Taal and the Pansipit river. Other shrimps belonging to the same family, Atyidae, are caught in the Central Visayas.

**Biology of Penaeid Shrimp in the Visayan Sea**

In 1976/77, Aprieto and Ingles conducted a study on the Biology of Penaeid Shrimp in the Visayan Sea (in the center of the country). It included: species composition and relative abundance in the catches, area and seasonal distribution of shrimps, in general, some aspects of the biology of major shrimp species and the ecological factors that may affect shrimp distribution and abundance in the Visayan Sea.

A survey was carried out by trawling on board a 190 GT research and training vessel (the M/V Albacore belonging to the UP College of Fisheries), from August 1976 to March, 1977. The trawl used was a two-seam trawl, 22 m wide and 46.5 m long with a mesh size of 3.0 cm in the codend.

About 13,600 kg of fish and 2,400 kg of invertebrates, of which about 100 kg or 4.24% were shrimps, were caught within eight months. It is worth observing that the shrimp catches were quite low compared to those of commercial trawlers operating on the area which average 10%-12% of shrimp in the total catch. Of the shrimps caught, 88.8 kg or 91% belonged to Subfamily Penaeidae, namely: *Penaeus semisulcatus*, *Penaeus monodon, Penaeus teraoi, Penaeus longistylus, Penaeus indicus,*

*Penaeus latisulcatus, Metapenaeus intermedius, Trachypenaeus fulvus, Parapenaeus longipes* and *Metapenaeopsis sp*: and the rest were non-Penaeidae. Among these, *Trachypenaeus fulvus* was the most abundant and widely distributed in the study area. Next in abundance was *Metapenaeopsis sp.* followed by *Penaeus semisulcatus.*

The largest catch were observed in December and January with 1.545 kg/haul and 1.459 kg/haul respectively. Catches during night time were greater than day time.

No significant correlation was found out between oceanographic parameters such as temperature and salinity and the abundance of shrimps.

**Marine Shrimp Resources of Luzon**

A study on the Marine Shrimp Resources of Luzon, including relative abundance of shrimps in Manila Bay, Tayabas Bay, Lingayen Gulf and Sorsogon Bay, was conducted by del Mundo, Agasen and Ricablanca in 1990 .

The marine shrimp resources in the area consist in four genera of shrimps: *Penaeus, Metapenaeus, Trachypenaeus,* and *Acetes*. According to the results of catch and effort, it was estimated, at that time, that shrimp resources were not fully exploited by commercial trawlers.

Among the fishing grounds surveyed, Sorsogon Bay had the highest density of shrimp with 2,129 kg/km2, in December, followed by Manila Bay with 589kg/km2 in March, Tayabas Bay with 37.57 kg/km$^2$ in February. The lowest was Lingayen Gulf with 28.29 kg/km$^2$ in March. It was observed that shrimps were particularly abundant in these areas during the northeast monsoon. The exploitation rate of certain species was estimated in given fishing areas: for *Metapenaeus dalli* in Sorsogon Bay, 0.525; for *Metapenaeus ensis* and *Penaeus indicus* in Manila Bay, 0.436 and 0.55 respectively. According to these estimates, the endeavor shrimp (*Metapenaeus ensis*) was therefore under exploited, at that time.

It is worth mentioning that the authors of the study recommended for Sorsogon Bay area that seasonal trawling ban or closed season (from February to June each year) be established for mini trawl. It was also recommended that mangrove swamps as critical habitat for young shrimps be carefully protected and all pollution prevented.

**Relative Abundance, Spawning and Recruitment of Banana Prawn (*Penaeus mergueinsis*) in Sorsogon Bay.**

Agasen and del Mundo (1991), in their study on the Relative Abundance, Spawning and Recruitment of Banana Prawn (*Penaeus merguiensis*) in Sorsogon Bay, presented the trends in the catch per unit effort (CPUE) over a three-year period, 1989-1991. In this study, the fishing activities were carried out day and night. The data used were obtained from the catches of fish corrals, gillnets and mini trawls. Prawns were identified from the monthly sampling activities. The carapace length, sex and maturity were also determined.

The abundance of white shrimp (*P. mergueinsis*) was observed by monitoring the catch of fish corrals installed near the mouth of Cadacang River. In 1989-1991, it was observed that the peak season for white shrimp was February to July. It was also observed that the highest CPUE ranged from 45 to 46 prawns per hour. The catch also depends on the moon period of fishing: It was higher during new moon and full moon. The highest CPUE for gillnet were 67 prawns/hr in October 1989 and 48 prawns/hr in September 1990. Among the fishing gears used, the mini trawl had the lowest CPUE. The highest were 28 prawns/hr, 15 prawns/hr and 5 prawns/hr in January 1989, August 19990 and in April 1991 respectively. It was also found that the catch with fish corral, gillnet and mini trawl between 1989 and 1991 depended, in general on the amount of rainfall which probably affected either the migrations of juveniles or the settlements and survival of post larvae while the importance of water temperature was not proved (except when, in 1990, orthe catch of gillnet was found increasing with it). A number of other environmental factors were also observed but were not found being so important.

**Capture Fisheries in San Miguel Bay**

From July 1992 to June 1993, an assessment was conducted in San Miguel Bay in order to optimize the catches and to estimate the sustainable level of fishing effort.

The annual total catch declined from 14,687 MT in 1981 to 6,495 MT in 1993. The shrimp catches, including Penaeid and Sergestid shrimps were 4,047.6 t or 22.8% of the total catch. During this period thirty five percent (35%) of the captures were made by trawlers. Finally, it is worth mentioning that according to the assessment, the fishery resources, including shrimps, were at that time heavily exploited in San Miguel Bay

**Capture Fisheries in Manila Bay**

A study on Fish Stock Assessment conducted in Manila Bay from November 1992 to October 1993 with among other objectives: to make an inventory of fishing gears, an assessment of actual prevailing fishing activities in the area, to estimate the average yields and, finally, to assess the level of exploitation of economically important fish and invertebrates.

It was found out in the study that the area was exploited by about twenty one (21) municipal and commercial fishing units. The main targets were demersal species and trawling was the major contributor to the fish production. A survey with trawl revealed that only 24.6% of the catch were invertebrates. In general, the statistics showed that the invertebrates (crustaceans and molluscs) might amount to 9% to 48% of the total catch.

**Selective Shrimp Trawling in Manila Bay**

A study on Selective Shrimp Trawling using "separator device" was recently conducted by Dickson in Manila Bay (1997). It was observed during the study that with an average catch rate of about 10 kg per hour, a 10.3% only were shrimps. By-catch species which included fishes and invertebrates other than shrimps contributed to about46.4% relative abundance) and 408.82 kg (43.3% relative abundance), respectively. Shrimp species included: brown rough shrimp (*Trachypenaeus fulvus*), 4.54%; tiger prawn (*Penaeus semisulcatus*), 3.52%; and greasy back shrimp (*Metapenaeus ensis*), 1.15%. It is worth mentioning that the quantities of shrimps caught were found slightly less when trawls are equipped with "separator device": a mean catch of 10.31 kg/hr against 9.79 kg/hr while the shrimps species composition was found almost similar.

**Future Research Priorities**

Mobile gears such as trawl and pushnet, have severe impact on fishery resources. Damage to sea bed and capacity of catching (with small meshes) all sizes of fish are some of the technological problems that need to be addressed. To prohibition of all utilization of such fishing gears may not be practically feasible because of these are well appropriate to the exploitation on this resources. However, practical solution should be found through a strong effort in technological research and development to minimize potential negative impacts.

The preservation of undersized fish when using trawls and seine nets requires in-depth studies regarding the appropriate mesh sizes for the different parts of the nets, in particular, in the codend of trawl. However, it is worth recognizing the difficulties in respect to the diversity of situations: fishing grounds, composition of the living resources, immediate constraints of the industry, etc.

It is recommended that efforts be made for an effective separation between target species and by-catch and the exclusion of endangered species such as turtles. More research is required concerning horizontal separation net panel and turtle-excluder devices. In respect to this, studies regarding the reaction of target and by-catch to trawl would have to be carried out. Important differences have already been recognized between fish swimming actively and, as such, capable of escaping through exit-holes in the upper panel of the netand shrimp remaining passive with less opportunities for escaping.

When trawling is carried out for catching high-value shrimp in priority, efforts are justified to develop effective by-catch reduction devices (BRDs). A BRD based on the utilization of a square mesh window

panel seems to be promising and research should be followed up in this respect. However, it is worth mentioning that, at the same time, it is essential to analyse carefully the practices of fishing operators towards by-catch in general in various shrimp fishing areas of the country. The existing demand for trash fish or by-catch and existing markets in many places have obviously to be taken into account for the monitoring of by-catch related matters. In addition, while developing any BRD, existing unavoidable by-catch (the quantities of which may vary much according to fishing grounds) have to be considered.

Another traditional fishing gear other than trawl for shrimp are gill nets. Some shrimp species (*Metapenaeus dobsonii* and *M. ensis*) are caught when their rostrum become entangled in the nets. The experience showed that to increase the catching efficiency of the gillnets on shrimp, it was worth folding the lower section of them as to making bags along the footrope.

In general, research work in fish behavior and fishing gear selectively, must be given priority. In respect to this, it should be observed that the lack of instruments for analysis and recording of environmental conditions is a difficulty in Fishing Technology R & D.

Tests/experiments of technologies having proven effectiveness in other countries is another interesting option.

## 6. IMPACT AND PERCEPTION ON SHRIMP EXPLOITATION

The exploitation of shrimps resources in the Philippines usually results to catches of other species, in greneral, including immature fish. As an average, trawlers in the Philippines have catches of shrimp to fish ratio ranging 19 to 10% or even less.

A lot of problems results from actual shrimp fisheries in the country. Mobile gears such as trawl and pushnet have severe impact on fishery resources, including through unwanted catch. Very fine meshed nets are used. Small-sized fish, invertebrates and mollusks,as unavoidable catch in addition to shrimps, are systematically discarded. In general, the shrimp trawling operations affect the breeding cycles of fish, shrimps and other sea-bottom dwellers. Observation of the catches already shows changes regarding species composition as well as sizes of fish. High valued species are less abundant. The continuous plowing of the bays and gulfs kills bottom organisms and prevent other to settle. In areas where intensive trawling has been carried out for a while, increase population of scavenges such as small crabs are found. At the same time, the overall fishing effort on shrimp is increasing and there is strong competition among shrimp trawlers in most bays and gulfs (the open-access situation still prevails).

The habitat of shrimp is characterized by soft muddy bottom. Many species, as by-catch, are uprooted from their natural habitats. Trawl fishing stirs up sediment that maybe transported to adjacent ecosystems and cause the suffocation of corals, shells and other marine organisms.

The negative environment and socioeconomic impact of trawling, including for shrimps, have long been experienced. The increase of trawling fleets increased problems between trawling and non-trawling fishers on the same fishing grounds. A common complaint from the non-trawling fishers is that once an area has been trawled, they can hardly catch a quantity enough for the subsistance of their families. Concerned with the environment and fishery issues, the small non-trawl fishers are requesting the closure of the major bays and gulfs to trawling. Tension between trawling and non-trawling fishers is now creating serious problems in various areas and sometimes lead to difficult relationships between fishers and administration whennon-trawl fishers are alleging that the local government officials favour the trawlers.

In general, trawl fishing is perceived by many as a destructive practice and a number of fishery researchers, officials and NGOs are recommending that shrimp fishing grounds are reserved for small fishers and the bays are closed from trawl. It is practically recommended the development of comprehensive fishery management plans aiming to phasing out trawl fishing from bays and gulfs.

It is worth reminding that after an enormous expansion from as early as 1960's, the trawl industry experienced a decline. The decrease of the catch per unit of effort, the average size of fish which are

landed and the quality of catch have progressively worried all various stakeholders. Several fishing grounds in the country are now recognized officially as overfished and ecologically impaired.

Catch efficiency data concerning target and incidental catch, and other information about trawling were collected from previous resource and ecological assessments in a number of bays potentailly endangered, and on area known as "traditional trawl fishing grounds", such as Sorsogon Bay, San Miguel Bay, Ragay Gulf and Manila Bay. A brief review on the status of trawl fisheries in pre-selected sites of Luzon Island, Philippines especially San Migule Bay is given below.

**An Opinion Survey regarding Environmental Changes and Fisheries in the San Miguel Bay**

The study was carried out on the seven municipalities of the San Miguel Bay; both officials and fishery operators were interviewed.

Almost 90% agreed that during the past several years, productivity of the San Miguel Bay has been declining as the increase in fishing effort with both trawls and other small scale fishing methods could not result in an increased catch. The decrease in the productivity of the fisheries did not only affect the fishers and their families but their whole communities and even other people indirectly depending on fishing. In general, commercial and municipal trawling are considered as main cause of problem; many people point out that "trawling is destructive to the environment" and not a selective fishing method because of the fine meshes which are used retaining all fish regardless of size. About 56% of the people alleged that the use of illegal and destructive fishing methods also contributes to the decline of production.

About 15% of the respondents reported damages to coral reefs in the San Miguel Bay's mouth; the coral reef areas would be affected by both trawling and dynamite fishing.

Conflicts regarding the use of marine resources

Conflicts between small fishers and trawlers have intensified since trawling activities have become more and more intensive in the bay. It was reported that trawling operations often damage nets laid by small scale fishers; fishers who target fish on coral reefs are also complaining that their gear are frequently destroyed.

A number of small scale fishers are also complaining about the use of explosives, chemicals and nets with fine meshes.

Fisheries Law Violations and Enforcement Problems

Eighty percent of the informants reported that the most violated fisheries law in the bay was the trawling ban. As early as 1950, an annual closed season for trawlers was established. While the Presidential Decree 1015 prohibited the operation of trawls using boats 3 GT or less, baby trawls could be used in areas 4 fm. deep or more if authorized by existing municipal ordinances. However, it is worth mentioning that in 1983, two Municipalities only had authorized baby trawls and one of them withdrew its authorization in 1987.

Enforcement Problems and Solutions

Enforcement of existing fisheries regulations in the bay area is considered as inadequate due to lack of staff, of surveillance vessels and of other facilities to properly monitor areas where illegal fishing is rampant.

Labor and employment opportunities

Small-scale fishing activities usually employ family labor in priority. Family manpower is maximized, precluding expenses for hired labor. Most, if not all, family members participate in the preparation of nets and other paraphernalia before setting out to sea and making or mending of nets.

In 1982, full or part time fishing was reported to be a major source of income in San Miguel Bay. Fishing alternatives in other sectors did not have the capacity to absorb labor from the fisheries sector or even to serve as a supplementary source of income for small fishers and their families.

Environmental Issues

Anyway, it was observed that the most important and urgent issue concerning the environmental status of San Miguel Bay was resource depletion (as shown by the general decrease in the catch). The decline in the bay's productivity was attributed to the use of depletive and destructive fishing methods, i.e. trawling, the use of dynamite or poisons. Weakness of fishery regulation, in general, and its implementation is also a serious problem.

## 7. NATIONAL IDENTIFICATION OF PRIORITY ISSUES REQUIRING ACTIONS

If reference is made to both recent surveysand published documents, the present exploitation of the shrimp resource is non-sustainable, at least, due to the catch of non-target species, immature fish, endangered species. It is therefore necessary to reduce or eliminate the capture of non-target species especially juveniles of commercially important food fishes.

Discussions among shrimp operators from Manila Bay, Ragay Gulf and San Miguel Bay, including with the participation of fishery administration and researchers had led to some recommendation such as, in priority to conduct experiment on various juveniles and by-catch reduction devices with the participation of affected stakeholders.

All or majority of the trawl operators including the crew of the vessel targeting or, only, catching shrimp resource lack awareness on the importance of other species caught during their operation. It is clear that discarding a lot of immature fish including crustaceans and mollusc during the course of operation make their work easy in the short terms but also assumed that such practice is, in the medium to long term, damaging to the resource and habitat. There must therefore be a strong effort made to increase the awareness of all concerned, in priority to fishers, concerning proper management of fishery resources, regulations regarding by catch and discards in trawl fisheries, the effect of catching immature fish and other species, including endangered ones, the use of by-catch and juveniles excluder devices for the long term sustainability of the fishing resources and their exploitation.

Considering the effect shrimp trawls have on other resources and with regards to finding solutions for reducing by-catch and increasing the target species, it is necessary that alternative fishing gears such as gillnets and trammel nets should be tried to assess their catching efficiency and selectivity. Technologies from other countries having shown being effective and selective should be considered for a transfer to the stakeholders in the country. At the same time, it would be suitable to look, as much as possible, for management measures other than closed season, such as limited entry for harvesting the shrimp resources so that other resources which is caught with shrimp will be reduced or eliminated. Besides, it is worth mentioning problems on certains shrimp fishing grounds such as Manila Bay: large quantities of wastage, including a lot of plastic material which are caught during fishing operations, up to 60% of the total catch, have to be sorted on the shrimp trawlers'deck which takes time leading to some deterioration of the shrimp and fish; it would be necessary that the national government and concerned agencies formulate programs to solve this problem.

The characteristics of existing shrimp trawlers, e.g. size and arrangement of the deck, and practices and attitude of the crews should be carefully considered when planning the introduction of by-catch minimization technologies. Even if fishery operators are involved in all discussions at the early stage of the development of by-catch reduction technology, it is worth keeping in mind that the introduction of such a technology will lead to some extra-cost. There is chance that many fishers be, for this reason, reluctant. It is, first, recommended that pilot tests involving the cooperation of shrimp trawlers be conducted.

## 8. A NATIONAL PLAN OF ACTION

While being dragged on the seabed, bottom trawls used for shrimp have some potentially negative impact on the habitat. More important right now is that shrimp trawls usually catch a significant amount of fish and invertebrates by-catch and that a large part of it is discarded at sea. The catch of

juveniles and low-value fish in large quantities is un-sustainable. Therefore reduction of by-catch, juveniles in particular, should be given appropriate and immediate attention. It is therefore necessary to have available data on by-catch specially discards.

A relevant Plan of Action could include three main components.

The impact of trawling is not well documented, in general. The first component would be the careful evaluation of the level of impact of shrimp trawling fisheries on the environment, both habitat and biodiversity. Four to six fishing grounds would be identified where shrimp are caught by trawlers and other gears. The study would consist in boarding shrimp trawlers to collect data on by-catch and discards and, as far as possible, to make observation regarding possible impact to the seabed, etc. Three to six months would have to be allocated to each fishing ground. At the same time, attention would have to be paid to the socio-economic conditions in various areas in the country since, as a matter of fact, these are very important factors for the perception of impact (short and long terms) of activities. A study over three fishing areas would have to be carried out in this respect.

The second component would be the design, testing and demonstration of by-catch and juvenile reduction devices (several designs imported from France (IFREMER), Australia and Thailand (the Southeast Asia Fisheries Development Centre (Training Department) SEAFDEC-TD) on board shrimp trawlers on various shrimp fishing grounds. Several type of BRDs would be constructed and tested on board commercial vessels in order to determine the most efficient in terms of shrimp retainment and escapement of by-catch specially juvenile of fish and endangered species. At the same time, alternative fishing gears/methods would be considered and incentives for it will have to be given to shrimp harvesting fishermen.

The third component would be the extension and dissemination in the concerned shrimp fisheries of the best and appropriate technology with the participation of leading fishermen/operators. The strategy could be to prepare a list of association of the fisherfolk engaged in shrimp harvesting and to give the responsibility for the introduction of environmentally friendly selective fishing gears (demonstration and extension work) to these groups. It is worth mentioning that a monitoring and evaluation of the technologies over a long enough period would be necessary with possible changes and adjustments to the devices as required to solve specific problems. Some involvement of local school of fisheries in the area would also be recommended, in particular for supporting research and monitoring.

By the end of the process, some policy for exploiation of the resources of shrimp harvesting would be to be formulated as the basis in the sustainable/responsible exploitation of the resource.

Finally, it is worth mentioning that networking with other countries involved in similar process for introduction of by-catch reduction technologies would be very suitable for exchanges of information on technical matters as well as on strategy and implementation programme.

**REFERENCES**

Armada, N. B., C. Hammer, J. Saeger and G.T. Silvestre, 1981. Results of the Samar Sea trawl survey. pp. 1-46. In J. Saeger (Ed..) Results of the Samar Trawl Survey. Tech. Rep. Dept. of Marine Fis., College of Fisheries, University of the Philippines (3):191p.

BFAR-Fishery Sector Project. 1995. Resource and Ecological Survey of Manila Bay. National Museum and MADECOR Technical Cooperation.

BFAR. 1997-1998. Philippine Fisheries Profile

Bureau of Agricultural Statistics, 1992-1997. Fisheries Statistics. Quezon Ave. Quezon City, Philippines.

Bureau of Agricultural Statistics. 12 Priority Bays of the Municipal Fishing Sector (1992-1995). Quezon Avenue, Quezon City, Philippines.

_____. Commercial Fishery Production (1992-1995).

Caces-Borja, R. Bustillo and S. Ganaden, Further observations on the Commercial Trawl Fishery in Manila Bay. Proc. Indo-Pacific Fish. Coun. 13. 631-637.

Cinco E., L. Perez, R. Gatchalian. 1996. Catch and Effort in the Sorsogon Bay Fisheries. Resource and Ecological Assessment of Sorsogon Bay, Vol III. pp. 52-78

Congress of the Philippines. 1998. The Fisheries Code (Republic Act No. 8550).

De Jesus, A.S. 1976. A report on the design, construction and operation of the German (Herman Engle Type) Trawl net in Manila Bay. Phil. Journal of Fisheries, Vol. 14. pp. 117-144.

Del Mundo, Corazon M., Edna V. Agasen, T. Ricablanca. 1990. The marine shrimp resources of Luzon. The Philippine Journal of Fisheries. Volume 21. pp. 45-66.

Dickson, J., R. Ramiscal, B. Magno, N. Lamarca, A. Santiago III and M. Chiuco, 1997. Experiments on Turtle Excluder Device (TED) in Manila Bay. BFAR report (unpublished).

Encina, V. B. A report on two-boat bottom trawl fishing in the Philippines. Proc. Indo-Pacific Fish Council, 13 (III). Philippine Fisheries Commission, Intramuros, Manila, Philippines

Ingles, Jose A. and Virginia L. Aprieto. 1983. A contribution to biology of Penaeid shrimps in the Visayan Sea. Fisheries Research Journal of the Philippines. 8 (2): July-December 1983. pp. 19-32.

Motoh, H. 1980. Fishing Gear for Prawn and Shrimp Used in the Philippines Today. Technical Report No. 5, Aquaculture Department, SEAFDEC. Pp. 1 - 43.

Ordoñez, J.A. 1985. A study of trash fish caught by otter trawl in the Visayan Sea. Phil. Journal of Fisheries, Vol. 18. pp. 1-76.

Ramiscal, R.V., B. Magno, A. Santiago III and M. Chiuco, 1996 Selectivity Experiments of Shrimp Trawl using Separator Panel in Manila Bay. BFAR Report (unpublished)

Ronquillo, I.A., P. Caces-Borja and A.N. Mines, 1959. Preliminary observation on the otter trawl fishery of Manila Bay. Proc. Indo-Pacific Fish. Coun., 13 III. 638-648.

_____. 1995. Resource and Ecological Survey of Ragay Gulf. University of the Philippines in the Visayas.

_____. 1996. Resource and Ecological Assessment of Sorsogon Bay. UB-Tech.

_____. Resource and Ecological Assessment of San Miguel Bay. ICLARM.

Silvestre, G., R. Federzon, J. Muñoz and D. Pauly, 1987. Over-exploitation of the demersal resources of Manila Bay and adjacent areas. Fisheries Newsletter, Vol. XVII. pp. 47-67.

SUNDERLIN, W.D. 1994 Socio Economic Characteristics of Communities and Fishing Households Bordering San Miguel Bay ICLARM in G. Silvestre, C. Luna and J. Padilla. Multidisciplinary assessment of the Fisheries in San Miguel Bay, Philippines (1992-1993). ICLARM Technical Report.

Umali, A. 1950. Guide to the Classification of Fishing Gear in the Philippines Res. Rep. 17, U.S. Fish and Wildlife Service, 165p. Figs. 1-53.

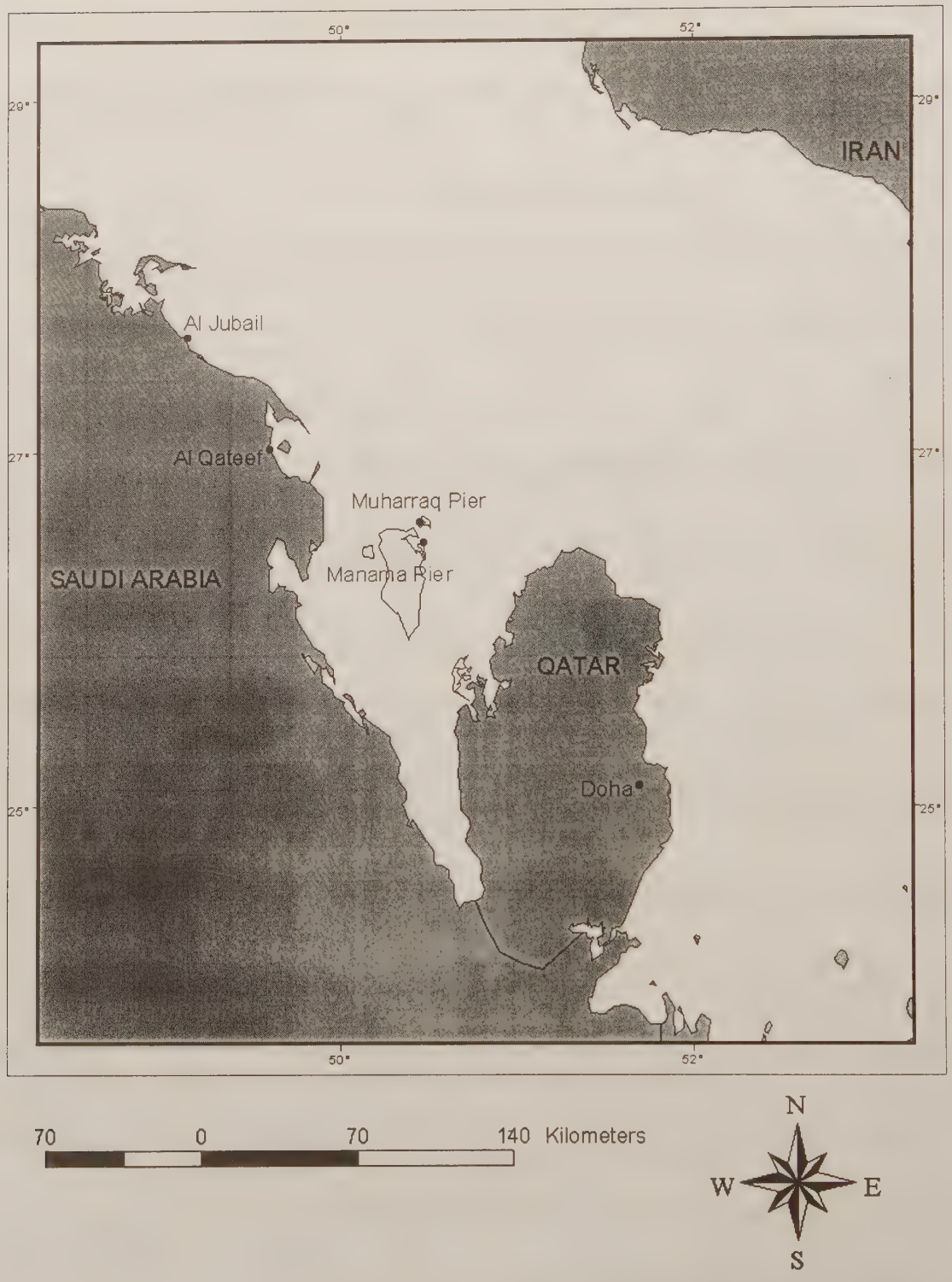
Warfel, H.E. and C. Manacop, 1950. Otter Trawling in the Philippine Waters. Research Report, 25:1-25.

# NEAR EAST

## BAHRAIN

### BAHRAIN SHRIMP FISHERY AND THE MARINE ENVIRONMENT

by Ebrahim A. A. Abdulqader, National Coordinator (Bahrain Center for Studies and Research; P.O. Box 496; Bahrain)



Abstract

The shrimp (95% *P. semisulcatus*) catch was 2 571 t in 1997 during the season authorized for shrimp fishing or nine months. (The fishing season is now being reduced from nine to six months.)

With a mesh size in the codend of 30 mm, which is common, the amount of by-catch is not known.

For the 1997/98 shrimp season, there were 306 licenced boats. The majority of them are 16-19 m in length doing single net stern trawling, mainly at night.

Bycatch Reduction Device has been tested with encouraging results.

The main problems reported include: some evidence of overfishing consisting in reduced catch rates and more small sized shrimp in the catch, by-catches of fish, including large quantities of juveniles that are so far discarded.

Resumen

En 1997, se capturaron 2.571 toneladas métricas de camarón (95% *P. semisulcatus*) durante la temporada reglamentaria de pesca, equivalente a nueve meses (actualmente la época de pesca está siendo reducida de nueve a seis meses).

La abertura de malla comúnmente utilizada en el copo es de 30 mm y no existe una cuantificación de la fauna de acompañamiento.

Entre 1997 y 1998, durante la temporada de captura de camarón, fueron expedidas 306 licencias a embarcaciones de pesca. La gran mayoría de estas embarcaciones tenían entre 16 y 19 metros de largo y estaban dedicadas a la pesca de arrastre por popa con una red, principalmente de noche.

Se han evaluado equipos para reducir la fauna de acompañamiento (BRD: "Bycatch Reduction Device"), obteniéndose resultados muy alentadores.

Los principales problemas reportados incluyen: algunas evidencias de sobre-pesca como la reducción en las tasas de capturas y mayor proporción de tallas pequeñas de camarón en la captura, pescado en la fauna de acompañamiento, incluyendo grandes cantidades de juveniles que son hasta ahora descartados.

## PREFACE

The preparatory phase of a global project on reducing the impact of tropical shrimp trawling fisheries on living marine resources through the adoption of environmentally friendly techniques and practices started in January 1999 and ended in June 2000.

The activities carried out by Bahrain during the project development phase included: 1) organizing a local workshop on 28 July 1999 entitled Workshop on reducing the impact of Bahrain shrimp fisheries on the marine environment by adopting environmentally friendly techniques and practices, 2 conducting an opinion survey using the FAO standard questionnaire (The results were published in a separate report (Uwate and Abdulqader, 1999), 3) preparing and printing a pamphlet (1 000 copies), 4) writing two reports, first on the results of the opinion survey and the second being the national report here'in included.

## 1. INTRODUCTION

Total shrimp landings were 2 571 tonnes in 1997 and formed 25.6% of Bahrain's total landings. Value at first sale was 3.5 million Bahrain Dinars (Fisheries Statistical Section, 1998a). This is equivalent to US$ 9.3 million. During the period 1980 to 1997, maximum shrimp landings were 3 565 tonnes in 1996, while lowest was 752 tonnes in 1992 during the Gulf war.

Shrimp is the most valuable species landed in Bahrain. Despite its importance, the shrimp fishery can play a negative role on the marine environment. This is due to the use of the trawl net, which is a low selective gear. In addition to shrimp, trawls pick up quantities of other fauna inhabiting the seabed. Shrimp trawls may contribute towards lowering the bio-diversity of the marine habitat. This report introduces the Bahrain shrimp fishery, and highlights its interaction with the marine environment.

## 2. THE HISTORY OF THE BAHRAIN SHRIMP FISHERY

Traditionally, the tidal barrier trap (local name: Hadhrah) was the main gear used for shrimp fishing in Bahrain. These traps are usually placed against the direction of shrimp migration. The importance of these traps in the local shrimp fishery was reduced after the introduction of trawling in 1967 (FAO, 1978). At present, trawl nets are responsible for most shrimp landings in Bahrain.

Bahrain Fishing Company (BFC) was the first established company to commercially exploit shrimp resources. This company started its fishing operations in March 1967 (FAO 1978). American and Japanese markets were the main purchasers of shrimp catches, most of which were exported as headless shrimp (Boreama and Job, 1968).

In the first two years of its operation, BFC operated eight trawlers. Eight more trawlers were soon added in 1968. Further, two more boats were added to the fleet in 1973 (FAO, 1978). In 1976 some of these trawlers were replaced and the total number reduced to 15 boats (FAO, 1978). All trawlers were double rigged (outrigger trawlers), using Gulf of Mexico trawl nets. Their headrope length ranged from 14 m in the case of small boats, to 17 m in the case of big boats. Mesh sizes of these nets ranged from 45 to 50 mm. All boats were steel hulled; their length ranged from 15 to 23 m.

BFC was the only company allowed to fish in Bahrain waters. The fishing season of this company usually started in Maniffa grounds off Saudi Arabia during July and August. From September to February, both Saudi and Bahrain grounds were fished (FAO, 1978). Total landings of this sector included the catches from both Bahrain and Saudi waters (Boerema and Job, 1968; Boerema, 1969; FAO, 1973; FAO 1978).

After a sharp decline in catches in the 1978/79 season and in the early 1979/80 season, shrimp trawling became uneconomical and the BFC ceased fishing in August 1979 (Abdulqader, 1983). A revival of the industrial sector of the Bahrain shrimp fishery started in 1980/81, but it experienced low catch rates. This fleet operated 4 double rigged trawlers which had been trawling for fish since 1975.

The artisanal trawl fishery started in 1971 (Abdulqader, 1983) by fishermen previously involved in the barrier trap fishing. In 1976, there were 26 full time shrimp trawlers in this category mainly operating from Sitrah jetty. All of these boats were made of wood known locally as "banoush". After the implementation of the registration and a licensing scheme in 1983, shrimp trawlers increased to 68 boats (Abdulqader, 1988). In 1985, the number increased to 495, with small boats forming 54% of the total.

From 1971 to 1985 artisanal shrimp fishermen were manually hauling the nets. Winches were introduced in 1986 by the Directorate of Fisheries. In 1997 about 86% of the fleet were equipped with winches.

Since the start of the artisanal shrimp fishery, the Sitrah pier was the main landing site for this sector. This was due to the closeness of this site to the main artisanal fishing grounds. After the implementation of a shrimp fishing ban period in 1980/81 (Abdulqader, 1982), the northern grounds became more important to the artisanal fleet. With that change the Manama landing site became an important shrimp landing site. The shrimp fishing ban regulation, and the introduction of winches, shifted the artisanal fleet to exploit deeper waters in the north.

Shrimp landings from industrial and artisanal fishing fleet are presented in Figure 1. High landings were observed for the industrial fleet before the crash of the fishery in 1979. The second period of industrial landings started in 1980 (Figure 1).

The increase in the size and fishing power of the artisanal fleet resulted in a gradual reduction of the industrial fleets role in shrimp fishing. The latter fleet was able to fish only for a few weeks of the season. In 1997, a decree was issued to totally ban fish trawling in Bahrain waters. This decree resulted in the removal of all industrial boats from the shrimp and fish fisheries. These boats had become dependent on fish trawling.

**Figure 1. Shrimp landings from artisanal (solid line) and industrial sectors from 1967/68 to 1993/94 fishing seasons. (Source: FAO 1978, and Fisheries Statistical Services, 1998a)**

From 1998, the Bahrain shrimp fishery was based only on the artisanal fleet. This fleet has grown over time and thus became very efficient. The word "artisanal" is no longer valid to define Bahrain's shrimping sector. A commercial sector is a more appropriate term to describe the present shrimp trawl fisheries

Catch and effort statistics for the Bahrain shrimp fishery are shown in Table 1. These statistics started with the second industrial sector period in 1980 and include the present time (1997/98). Effort data were standardized to artisanal effort units (Abdulqader, 1995). Due to the changing fishing behaviour of the artisanal sector throughout this period, standard effort was calculated based on the catch rate ratios for each season. The standard effort was calculated by converting the industrial fishing hours to artisanal hours using the following equation:

$$F = F_A + (F_I \times (U_I / U_A))$$

Where $F$ is the total standard effort

$F_A$ is the artisanal effort

$F_I$ is the industrial effort

$U_I$ is the industrial catch rate

$U_A$ is the artisanal catch rate

**TABLE 1. Shrimp total catch and artisanal, industrial, and standard effort for the 1979/80 to 1997/98 shrimping season**

| SEASON | Catch In Tonnes | EFFORT IN FISHING HOURS (x 1 000) | | | CATCH Rates |
|---|---|---|---|---|---|
| | | Artisanal | Industrial | Total | |
| 80/81 | 625.5 | 27.0 | 5.1 | 34.6 | 18.1 |
| 81/82 | 543.5 | 24.1 | 6.0 | 46.8 | 11.6 |
| 82/83 | 685.4 | 37.5 | 8.6 | 75.1 | 9.1 |
| 83/84 | 727.5 | 42.0 | 10.2 | 80.7 | 9.0 |
| 84/85 | 778.1 | 54.1 | 10.4 | 93.6 | 8.3 |
| 85/86 | 1444.2 | 54.6 | 7.2 | 87.1 | 16.6 |
| 86/87 | 1313.2 | 66.7 | 5.3 | 97.7 | 13.4 |
| 87/88 | 1695.1 | 86.7 | 11.9 | 146.0 | 11.6 |
| 88/89 | 1072.6 | 145.6 | 12.5 | 184.4 | 5.8 |
| 89/90 | 1258.2 | 158.0 | 15.3 | 176.4 | 7.1 |
| 90/91 | 1150.8 | 154.4 | 7.3 | 186.5 | 6.2 |
| 91/92 | 620.4 | 153.8 | 4.0 | 162.7 | 3.8 |
| 92/93 | 806.7 | 178.6 | 3.5 | 187.6 | 4.3 |
| 93/94 | 2079.3 | 229.5 | 1.8 | 234.7 | 8.9 |
| 94/95 | 1115.5 | 226.4 | 1.4 | 256.8 | 4.3 |
| 95/96 | 1666.0 | 232.2 | .5 | 234.0 | 7.1 |
| 96/97 | 3799.8 | 316.2 | 1.6 | 319.1 | 11.9 |
| 97/98 | 2247.0 | 366.6 | 1.1 | 371.9 | 6.0 |

Source (Fisheries Statistical Section, 1998a)

Total catch and standard effort are shown in Figure 2 for seasons 1980/81 to 1997/98. Clear increasing trend in the effort appeared from 1986/87 season. Catch varies with the highest peak being in the 1996/97 season. After the collapse of the fishery in the late 1970s, low catches were seen till the 1984/85 season. Similar low catches were seen again in the post Gulf war period, in the 1991/92 and 1992/93 seasons.

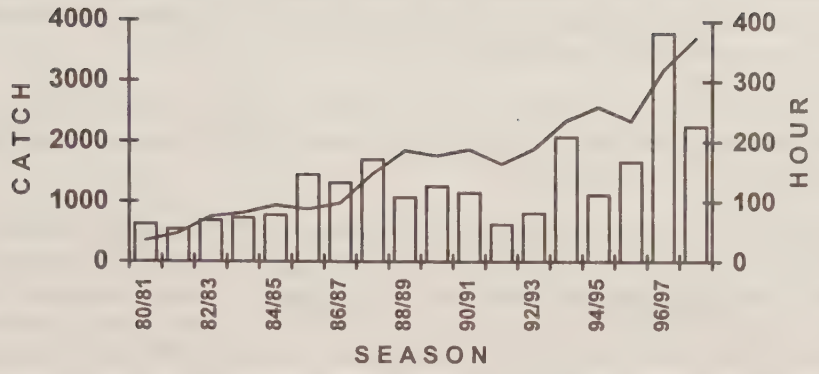



**Figure 2. Shrimp total catch (bars, in tonnes) and standard fishing hours (x 1 000) for Bahrain shrimp fleet for the season 1980/81 to 1996/97. Source (Fisheries Statistical Section, 1998a)**

The 1980/81 and 1985/86 high catch rates (Figure 3) were during periods of reduced fishing effort. The 1985/86 high catch rates (Figure 3) stimulated an increase in effort. This caused the decline in catch rates of the successive seasons.

## 3. SHRIMP FISHERIES STATISTICS COLLECTION METHODS

For shrimp fishery, two schemes are currently used in the collection of statistics.

First scheme is based on the stratified random sampling (Abdulqader, 1986). This scheme originally allows three visits for each major landing site in a month. In each day, landing and fishing efforts are recorded per boat, per fishing gear, and per fish species. The total daily shrimp landings and efforts are estimated by multiplying the average landing per boat by total number of boats landed at the sampling day. Monthly landings and effort are estimated by multiplying the average daily estimates of three sampling days by number of landing days.

As the sampling is conducted in the landing sites, the sampling scheme generates statistics on shrimp landings not on shrimp catches. In case of Bahrain, most of shrimp catches are landed. Landing statistics, therefore, were considered to represent catch statistics. Fishing hour is the unit used to represent the fishing effort. Complete statistics were produced by this scheme since 1979 until the present time.

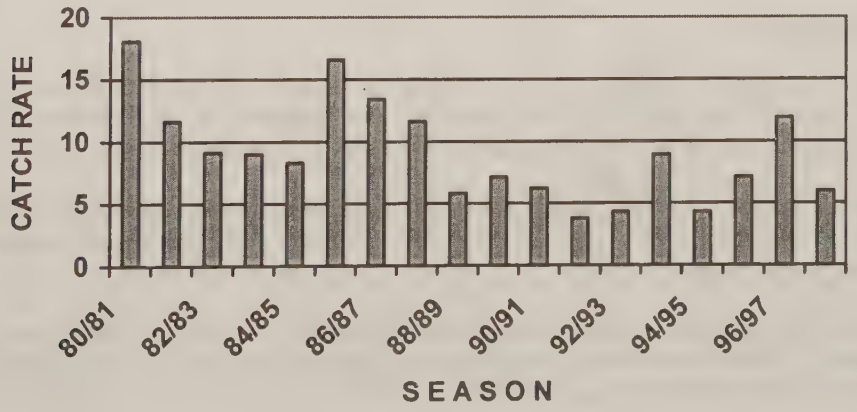



**Figure 3. Standard catch per unit of effort for the seasons 1980/81 to 1997/98.**

Since 1985, a logbook or reporting scheme expanded to all shrimp fishing boats (Abdulqader, 1988). Earlier, this scheme was used for the industrial steel-hulled boats. Shrimp skippers/owners are required to record their daily fishing activities in a monthly standard report (Appendix 1). Submission of the fishing reports is a prerequisite to boat licensing.

Unlike the sampling scheme, the logbook scheme provides catch statistics related to the fishing grounds. This logbook scheme provides more detailed catch and effort statistics. Statistics generated by this scheme have not been published yet.

The fishing logbooks scheme provided the basis for development of the Shrimp Fisheries Monitoring Program (SFMP). This program utilizes several database types including: logbook data, boat and owner registration details, fishing area details, shrimp sizes (number per kg), boat price, engine price, winch price, fish price, and cost of fishing (Abdulqader and Mehic, 1996). SFMP generates reports in the form of tables, figures and maps. Catch, effort and catch per unit of effort can be presented for any selected time period and boat size in a map format. Based on shrimp size data, the program has a subroutine to convert shrimp catches to numbers, and to display shrimp density in various grounds. The system contains a subroutine to generate cost and revenue reports for a selected time period and boat size.

The SFMP is now operational, but still it is not providing information to the fisheries managers because there is a shortage in budget and staff.

## 4. THE SHRIMP FISHERY

Shrimp resources

Seven penaeid species were found in Bahrain waters (Abdulqader, 1999). Commercial shrimp landings are mainly from a single species, *Penaues semisulcatus*. The six other remaining species makes about 5% of the annual shrimp landings. Two species *P. latisulcatus* and *Metapenaeus kutchensis* grow to good size. The remaining four species *M. stebbingi, Trachypenaeus curvirostris, Metapenaeopsis stridulans,* and *M. mogiensis* are smaller and are usually partially or entirely discarded. Catches of small sized shrimp frequently exceed the amount of big shrimp catches at the end of the season (February and March).

The shrimp fishing grounds extend from a depth of 2 to 20 m. There are three major shrimping areas: western, northern and southern area. The approximate locations of the shrimp fishing grounds were determined with fishermen's assistance (Abdulqader & Mehic,1996) and are illustrated in Figure 4. Fishermen identified fifty shrimp fishing grounds within Bahrain waters. Local names are used to identify these grounds. Total shrimping area is estimated at about 871 $km^2$. Ghumais fishing ground located at the south, is the biggest fishing ground (area 163 $km^2$), it makes up 18.7% of the total shrimping area. The second important ground is Umm-Adood (area 105 $km^2$) found in the north, which makes 12.1% of the total shrimp grounds.

Fishing Vessel and Gear

Bahrain shrimp fishing boats vary in size and composition. Wood is the traditional material used in boatbuilding. Recently, the number of fibreglass boats has increased. Low maintenance cost and lighter weight are to the advantage of the fibreglass boats which fishermen now prefer.

Regardless of the building material used; all big and medium size boats are built following the traditional boat design which is well known in the Arabian Gulf area and adjacent seas. Banoush is the local name used for these boats.

Most of big and medium boats are equipped with winches, while in most of the small boats, nets are retrieved manually. Most of the fishing boats use second hand car engines or diesel engines to power their winches. Also many shrimp boats use hydraulic winches.

In the 1997/98, thetotal number of shrimp boats was 335 boats. About 14% of these boats had no winch; 49% were fibreglass boats. For the shrimp season, 306 boats were licensed (for some reason 29 boats did not renew their fishing licence).

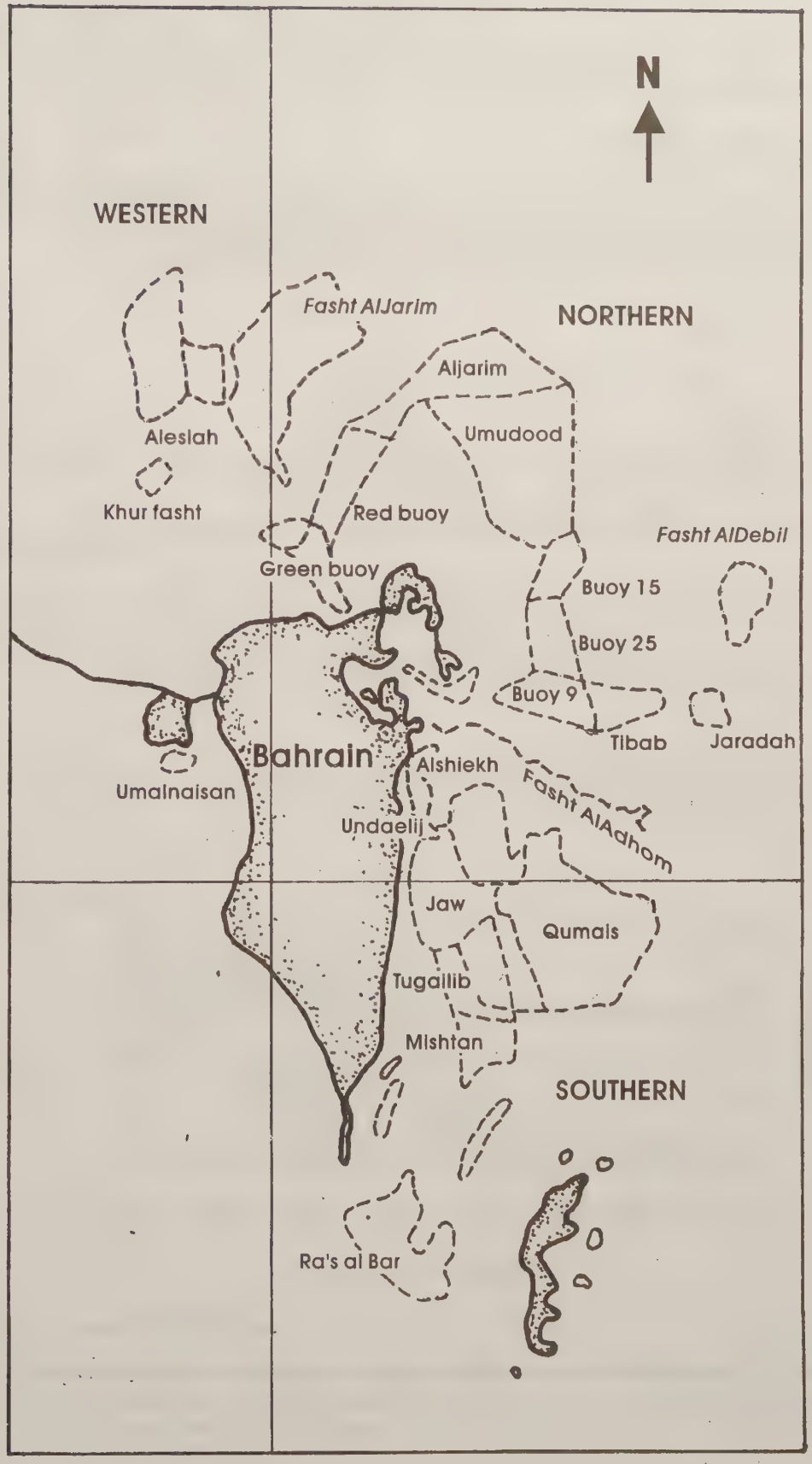



**Figure 4. Bahrain shrimp grounds within three main areas. Major coral reefs (Fasht AlJarim, Fasht AlAdhom, and Fasht AlDebil) and land areas also indicated.**

During the 1997 shrimp closed period, all shrimp boats were examined and their specifications were verified and recorded. This includes boat, engine, winch specifications. These records were entered in the SFMP. The 1997 data on fishing fleet specification are the most recent information on the fleet. Detailed description of the fleet is presented below. These results were obtained from the SFMP.

Boat Size Frequency Distribution

Bahrain shrimp fleet includes boats from 5 to 23 m in total length. The majority of these boats are about 16 m length. The Bahrain fleet contains a considerable number of small boats. Length frequency for all shrimp boats, with and without winch included, is shown in Figure 5.

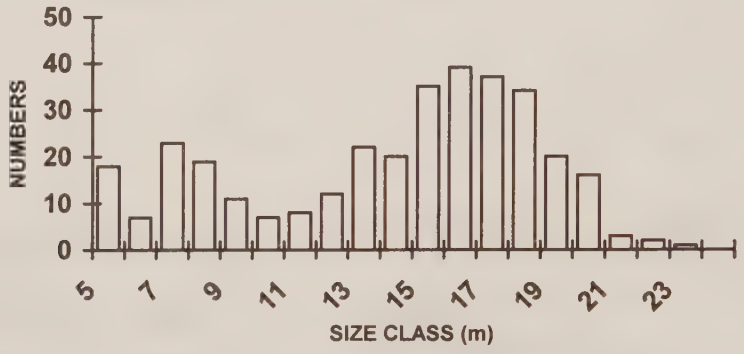



**Figure 5. Number of boats found within specific size class for all boats.**

Figures 6 shows length frequency distribution of boats with winch and Figure 7, those without winch. Most boats without winch are small and most operate in shallow waters.

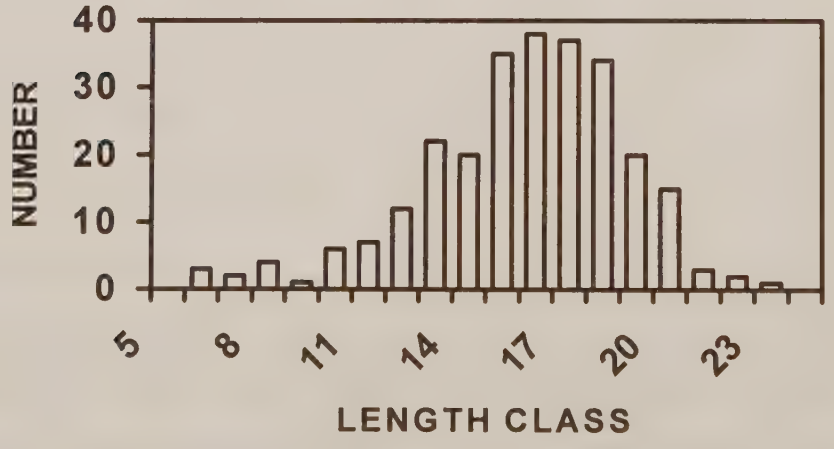



**Figure 6. Number of boats found within specific size class for all boats with winch**

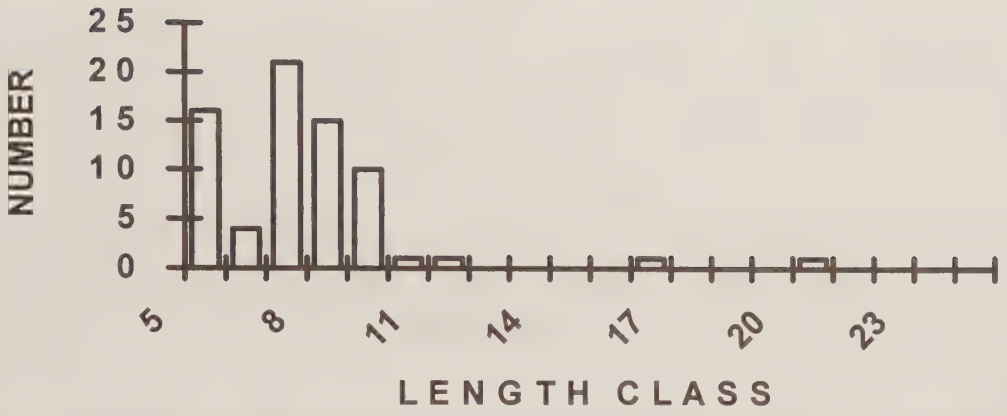



**Figure 7. Number of boats found within specific size class for all boats without winch**

Boat Age Distribution

The SFMP provides information about the boat age. Figure 8 shows the age distribution of Bahrain shrimp fishing fleet in year 1998. In Bahrain's shrimp fleet there are boats more than 28 years old. Most boats are between 0 to 26 years old. Many boats are new to the fishery.

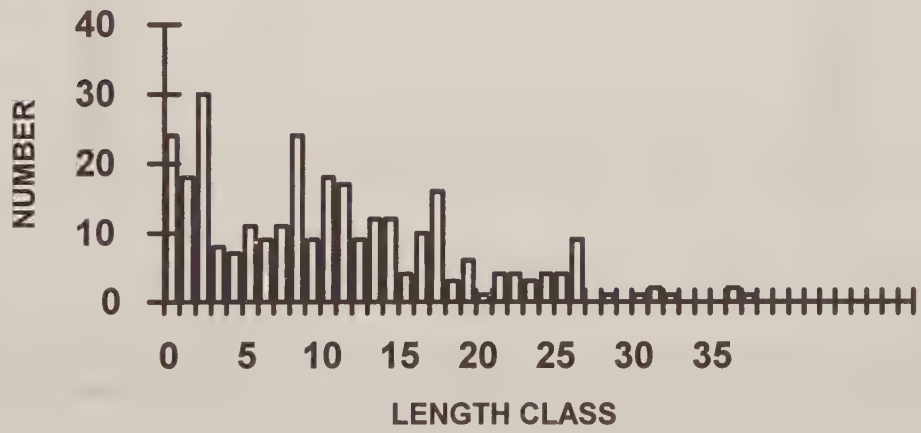



**Figure 8. Number of boats found within specific age class for all boats**

Boat Engine Horsepower Distribution

All boats used in the present shrimp fishery are powered either with outboard (class A boats), or inboard engines. Engines of 300, 200 and 50 horsepower are most common in the Bahrain shrimp boats (Figure 9). The 450 horsepower engines are used by steel hulled boats. These steel boats were banned from the Bahrain shrimp fishing fleet in 1997.

**Figure 9. Number of boats found within specific engine horsepower class for all boats**

Boat Origin

Most of Bahrain shrimp boats were built in Bahrain and the United Arab Emirates (Figure 10). Most of boats built in UAE are fiberglass big boats, while most boatsbuilt in Bahrain are wooden boats.

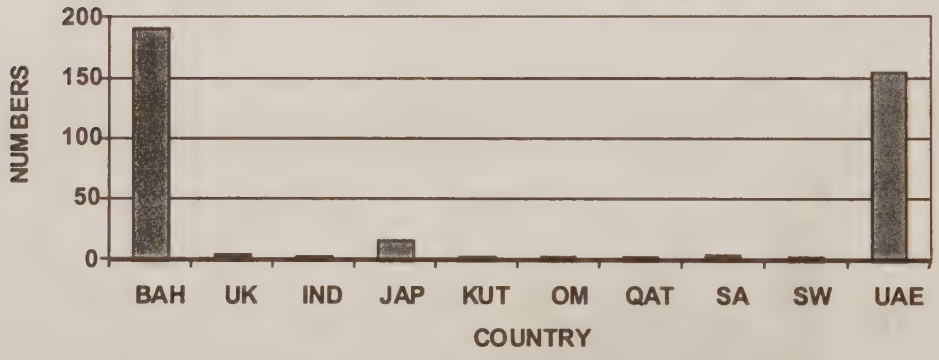



**Figure 10. Frequency of shrimp boats per country of origin. BAH = Bahrain, UK = England, IND = India, JAP = Japan, KUT = Kuwait, OM = Oman, QAT = Qatar, SA = Saudi Arabia, SW = Sweden, UAE = United Arab Emirates**

Shrimp Fishing Nets

A single net of the Gulf of Mexico flat type is used per fishing boat. According to the boat size, nets varied in size from 5 to 24 fathoms footrope lengths. Cod ends are usually made of 1.182 inches (30mm), 65 twin netting. The remainder of the net is usually made of 1.5 inches (38mm), 35 twin netting. One or two rows of chains (8mm thickness) are usually used. Nets equipped with two rows of chain are towed in higher speed.

Doors used with net are made of wood. Steel is used in these doors to support wood pieces, and to form the door base. The common door used is 140cm length by 70cm width, and about 80 kg in weight.

Fishing Technology

Most of shrimp fishermen depend on GPS navigation in their fishing operations. Fishermen realized the importance of GPS in minimizing sailing time and preventing the loss of nets. GPS stores the co-ordinates of hazard locations, which will enable the fishermen to avoid dangerous locations during their fishing. Most large boats use both GPS and echo sounders. Several large boats are using mobile phones to communicate between boats, and between boats and land.

## 5. SHRIMP FISHING PRACTICE

Shrimp fishing in Bahrain is a daily operation. Boats usually depart from the jetties in the late afternoon and return just after sunrise. In seasons of high catch rates, shrimp fishing can be done during the daytime at the beginning of the season. However, Bahrain shrimp fishing is mainly a night operation.

All shrimp fishing boats trawl with a single net. These nets are released from the stern of the boats. The release of the doors and the forward movement of the boat facilitate the movement of the net to the sea bottom. Nylon rope of about 26mm diameter is usually used to haul the trawl net. This rope is stored on the winch, which is usually mounted toward the bow of the boat.

Trawling by big and medium boats is normally conducted at about 3.5 knots. However, some of the big boats use double chain rows on the footrope of large nets (over 20 fathom footrope). They are able to trawl at 5 knots speed. Practically, the boats with more chain on their trawl which are sweeping bigger area have more fishing power than those using a single row of chain. However, this practice reduces engine life.

Trawl duration varies with the boat size and the catch quantities. Small boats trawl for 15 minutes in cases of high catch rates, while the trawling period may extend to one hour when catches are low. This is because net hauling is carried out manually. Bigger boats may trawl up to two hours. Despite the use of a winch, there are limitations for hauling the bag onto the deck which is usually done manually.

The catch is sorted into shrimp, crab, and commercial fishes. The remaining catch is discarded at the sea. This last portion usually includes non-commercial fish, juveniles of commercial fishes and occasionally marine turtles. At end of the season, catches usually contain significant quantities of small shrimps other than *P. semisulcatus*. These shrimp are partially kept during the periods of high market demand.

After sorting the catch, the shrimp is usually washed with seawater and stored in chilled brine. Shrimp catches are usually stored in 40 kg insulated boxes. Shrimp catches are kept in these boxes during the transfer to the auction market.

## 6. SOCIAL ASPECTS

Previously, the term artisanal was used to distinguish the smaler wooden boats from the steel hull ones. The artisanal fleet is now dominant in the shrimp fishery in term of fishing power. The term artisanal is not used anymore to describe this sector. Detailed specifications of Bahrain's shrimping fleet are discussed in section 4.

In 1976, among the 26 wooden boats, ranging from 6 to 17 m in length, involved on a full time basis in shrimp fishing (FAO, 1978), 18 were operating from Sitrah pier. Their fishing area was restricted to the shallow areas found in the south and around Muharaq Island. All fishermen working on these boats were Bahraini (personal observation). Boats were managed on a family basis and, normally, own by their captains. Fishing revenues were distributed mainly to members of the family. As trawling was introduced only in 1971, the experience of these fishermen was limited. Nets were retrieved manually, resulting in the use of small nets and the need for relatively large crew.

From the mid 1980s, the number of foreign fishermen on shrimp boats increased because they were less costly. Also, use of foreign workers was encouraged by the government to meet country development requirements in all sectors. This resulted in the appearance of another type of boat ownership. The new owners were investors who did not directly participate anymore in shrimp fishing

and depended on foreign crews. Using foreign crews allowed the owners/investors to operate several boats. Now, some owners own up to 7 boats. About 95% of the shrimp fishermen are foreigners.

Foreign fishermen come from different cultures, but primarily from India. A considerable percentage of these fishermen possesses only a basic education.

The increase in foreign fishermen has resulted in less Bahraini going for fishing. A number of Bahraini, former fishermen, now owns and manages two or more boats.

Most of the shrimp fishing boats are found at three main landing sites. These are Manama, Sitrah, and Muharaqe pier. The basic services (electricity, water and jetty) are found in these landing sites. Dry docks and mooring areas are available for hull maintenance.

Most of the shrimp fishing boat owners use the share system for distributing the catch revenue. This is done on a daily, weekly or monthly basis. Costs of fishing (fuel, oil, water and ice) are calculated and subtracted from the total shrimp revenue. The resultant amount is divided into two halves. One half goes to the boat owner as depreciation and maintenance cost for the boat and engine. The second half is divided into shares. One share is for each fisherman (including the captain). In addition one share is for the car driver and another share for the boat winch. The boat captain receives an additional half share from the owner of the boat.

## 7. CATCH AND EFFORT DISTRIBUTION BY FISHING AREA AND BOAT SIZE CLASS

As already mentioned, a special computer program known as Shrimp Fisheries Monitoring Program (SFMP) was developed for the processing of the fishing log data (see section 3). Only 1997/98 data has been entered in this programme and a summary of catch and effort data produced by SFMP is presented in this section. For the 1997/98 nine and half months shrimp seasonthe total catch was 2507.9 tonnes and effort estimated by SFMP to 416.2 thousand of hours. These estimates are about 11% higher than the estimates provided by sampling scheme (see section 3), which are, for the same season, a total catch of 2247.0 tonnes for an effort amounting to 371.9 thousand hours.

Shrimp catch and effort distribution by boat size

The Shrimp Fisheries Monitoring Program (SFMP0) has classified the shrimp boats into 5 classes, i.e.: class A (<= 5.9 m); class B (6 – 10.9 m); class C (11 – 15.9 m); class D (16 – 25.9 m); and class E (=> 26 m) classes.

A summary of 1997/98 season is produced in Table 2. Catch rate increases with increase in boat sizes class. Boats class D were responsible for most shrimp catches. Boat class A had the lowest catch rate.

**TABLE 2. Boat size class, catch, effort (x 1 000 trawl hours), and catch rate (kg/ trawl hour) for the season 1997/98. SFMP outputs**

| BOAT SIZE CLASS | CATCH (TONNES) | EFFORT (HOURS) | CATCH RATE |
|---|---|---|---|
| A | 0.8 | 0.4 | 1.8 |
| B | 76.5 | 17.9 | 4.3 |
| C | 637.8 | 130.6 | 4.9 |
| D | 1792.9 | 267.3 | 6.7 |

Catch, effort, and catch per unit of effort for different boat sizes and months are presented in Tables 3, 4, and 5 respectively. For the period July 1997 to March 1998, the catches were the highest the first month (Table 3). This month, the Effort was slightly higher than effort in successive months (Table 4). The catch per unit of effort of the boats more than 11 m (Class C and D) was also found the highest in July 1997 (Table 5). It is worth observing that in February and March 1998 the smaller boats (class A) had to stop fishing because they were not able to move to deeper waters where the bigger boats caught the shrimp.

**TABLE 3. Shrimp catches (in tonnes) per month by boat size class for the 1997/98 season. (SFMP outputs)**

| MONTH | Size A | Size B | Size C | Size D | TOTAL |
|---|---|---|---|---|---|
| July 97 | 0.2 | 21.8 | 169.0 | 555.1 | 746.1 |
| August | 0.3 | 9.8 | 104.8 | 253.7 | 368.6 |
| September | 0.05 | 11.4 | 79.1 | 193.4 | 283.9 |
| October | 0.1 | 10.6 | 73.9 | 173.5 | 258.0 |
| November | 0.04 | 8.4 | 64.9 | 162.2 | 235.6 |
| December | 0.1 | 6.4 | 51.1 | 153.6 | 211.2 |
| January 98 | 0.004 | 3.3 | 35.6 | 124.4 | 163.3 |
| February | 0 | 2.6 | 27.3 | 86.2 | 116.2 |
| March | 0 | 2.2 | 32.0 | 90.7 | 125.0 |
| Total | 0.8 | 76.5 | 637.8 | 1792.9 | 2 507.9 |

Catch and Effort Distribution by Fishing Ground

A summary of 1997/98 catch and effort data per fishing ground is provided in Table 6.

About 66% of efforts were spent in Ummdood and Ghamais fishing grounds. These are the main fishing grounds in the northern and southern areas respectively. Further, about 69% of total catch was taken from these two grounds. Catch rates in these grounds were 6.5 and 6 kg/hr.

**TABLE 4. Effort (in thousands of hours) per month by boat size class for the 1997/98 season. (SFMP outputs)**

| MONTH | Size A | Size B | Size C | Size D | TOTAL |
|---|---|---|---|---|---|
| July 97 | 0.1 | 3.4 | 18.8 | 33.9 | 56.1 |
| August | 0.1 | 1.5 | 17.2 | 31.4 | 50.1 |
| September | 0.05 | 2.5 | 15.2 | 28.8 | 46.6 |
| October | 0.05 | 2.6 | 16.3 | 30.6 | 49.5 |
| November | 0.05 | 2.3 | 16.3 | 31.7 | 50.3 |
| December | 0.1 | 2.1 | 14.4 | 31.7 | 48.3 |
| January 98 | 0.002 | 1.5 | 11.3 | 28.2 | 40.9 |
| February | 0 | 1.2 | 9.7 | 24.2 | 35.1 |
| March | 0 | 1.0 | 11.5 | 26.8 | 39.3 |
| Total | 0.4 | 17.9 | 130.6 | 267.3 | 416.2 |

**TABLE 5. Catch per unit of effort (kg / fishing hour) per month by boat size class for the 1997/98 season. (SFMP outputs)**

| MONTH | Size A | Size B | Size C | Size D |
|---|---|---|---|---|
| July 97 | 2.1 | 6.5 | 9.0 | 16.4 |
| August | 2.7 | 6.7 | 6.1 | 8.1 |
| September | 0.9 | 4.6 | 5.2 | 6.7 |
| October | 1.5 | 4.1 | 4.5 | 5.7 |
| November | 1.1 | 3.71 | 4 | 5.1 |
| December | 1.2 | 3.1 | 3.5 | 4.8 |
| January 98 | 2 | 2.3 | 3.2 | 4.4 |
| February | 0 | 2.2 | 2.8 | 3.6 |
| March | 0 | 2.2 | 2.8 | 3.4 |

High catch rates, more than 10 kg/hr, were found in several grounds: Buoy 25, Ras Albar, and Al hadid Wasalb E (Table 6) but, however, the effort was little. Green buoy and Red buoy grounds in the north, and Shaik Ebrahim island received a considerable amount of fishing effort but the Catch rates from these areas were lower than from Ummdood and Ghamais.

The lowest catch rate was recorded from Tubli Bay (Table 6). The effort was also little in this area were usually only small boats (Class A) fish.

## 8. SHRIMP BY-CATCH ASSESSMENT

"By-catch" is a group name used to identify all fauna (except for shrimp) found in the catches of shrimp trawls. The word "discard" is a group name used to identify by-catch species being discarded at sea because of their low economic value. These definitions are adopted in this report.

**TABLE 6. Total catch, effort, and catch per unit of effort (kilo per hour) per fishing ground for the 1997/98 shrimping season, see Figure 4 for location of these grounds. (SFMP outputs)**

| FISHING AREA | CATCH IN TONNES | EFFORT (x1000 hours) | CATCH RATE |
|---|---|---|---|
| Aleslah | 81.6 | 12.3 | 6.7 |
| Khur Fasht NW | 10.8 | 1.5 | 7.3 |
| Albab | 2.3 | 0.4 | 6.2 |
| Aldoba | 1.0 | 0.2 | 3.9 |
| Green Bouy | 122.6 | 21.8 | 5.6 |
| Red Bouy | 111.0 | 20.8 | 5.3 |
| E Doba | 3.2 | 1.2 | 2.6 |
| Aljarim E | 0.4 | 0.2 | 2.2 |
| Ummdood | 970.3 | 149.3 | 6.5 |
| Bouy 15 | 42.2 | 5.8 | 7.3 |
| Bouy 25 | 32.4 | 2.5 | 13.0 |
| Alghazarah | 4.0 | 0.9 | 4.2 |
| Tubab | 18.3 | 2.0 | 9.0 |
| Qitat Jaradah | 24.6 | 4.5 | 5.5 |
| Tubli Bay | 1.4 | 0.7 | 2.1 |
| Mina Sulman | 13.1 | 4.9 | 2.7 |
| Dry Dock | 30.3 | 6.2 | 4.8 |
| Al hadid Wasalb E | 52.8 | 5.2 | 10.1 |
| Asheeb | 6.8 | 0.7 | 9.6 |
| Trekat N | 0.2 | 0.04 | 4.3 |
| Pump house | 2.2 | 0.8 | 2.9 |
| Alhadher | 0.5 | 0.1 | 4.2 |
| Shaik Ebrahim island | 140.0 | 30.3 | 4.6 |
| Tal Hayar | 0.3 | 0.1 | 2.3 |
| Ummjalid | 14.3 | 2.6 | 5.6 |
| Jaw | 23.6 | 5.6 | 4.2 |
| Reg Ghamais | 1.3 | 0.4 | 3.5 |
| Ghamais | 767.3 | 128.8 | 6.0 |
| Tighilib W | 19.1 | 4.4 | 4.4 |
| Mishtan | 6.6 | 1.4 | 4.7 |
| Ras Albar | 0.7 | 0.1 | 12.6 |
| Umm Alnassan | 1.7 | 0.3 | 5.1 |
| Buoy 3 | 0.3 | 0.1 | 3.7 |
| **TOTAL** | 2507.1 | 416.0 | 6.0 |

In Bahrain, by-catch generated by trawling activities has been studied for a relatively long period. This topic is still considered as one of the most important areas of current research work. From the 1980s

until the present time, three major by-catch studies have been conducted. The first was carried out for 13 months paralleling the first shrimp survey (from June 1980 to June 1981). The second study was carried out for two years (from January 1983 to February 1985). This work assessed both fish and shrimp trawl by-catch. The third by-catch study is conducted parallel to the present GCC regional shrimp survey. This survey started in March 1999 and will continue for two years.

First Shrimp Survey (June 80 to June 81)

Details of this study were documented in Abdulqader, 1986. In the study, one industrial fishing vessel was allocated for this survey for 3 days per month. The sampling was conducted under normal fishing conditions, but using a single Gulf of Mexico flat trawl. The size of the net used was 27 m at the headrope.

Sampling was conducted at fixed stations. These stations (27) were selected within the defined limits of Bahrain's shrimp fishing grounds (Figure 11). Each sampling station was trawled once a month for 45 minutes.

After sorting the shrimp, big and small fish were recorded by weight. The number of fish was also recorded in the case of big fish. The weight was obtained either by visual estimation (in the case of big fish), or by using standard baskets. A 5 kg random sample was collected from each sampling station. In the laboratory, these samples were sorted to species level. Number and weight of different species were recorded. Records were also collected on the incidental catches of sea turtles, the number and estimated weight of which were recorded.

During this survey, more than 90 fish species were identified in the shrimp by-catch. In addition, several invertebrate species were also found in the by-catch. The scientific names of these species and their family or group names are presented in Appendix 2.

Species occurrence was used to assess the abundance of the species in shrimp by-catch (Abdulqader, 1986). Species occurrence is a ratio of the stations where the species were present, to the total stations trawled during the month. For this calculation, only the qualitative data were used. Occurrence values ranged from 1, when a species was present in all stations, to 0 when a species was absent from all sampled stations. The overall occurrence is calculated by simple averaging of monthly figures.

Based on this survey, the overall occurrence was calculated for each species (Abdulqader, 1986). The various species were categorized according to their occurrence score into dominant (>0.5), common (0.3 – 0.5), less common (0.1-0.3), occasional (0.01-0.1), and rare species (<0.01). Based on occurrence score, 11 species were dominant in the shrimp by-catch, these are, *Gerres oyena, Paramonachanthus* sp., *Pomadasys stridens, Scolopsis taeniatus, Upeneus tragula, Lethrinus lentjan, Selaroides leptolepis, Siganus canaliculatus, Nemipterus bleekeri, Rhabdosargus haffara,* and *Upeneus sulphureous*. Also 6 species were found common, 27 species less common, 41 species occasional, and 14 species were rarely observed.

The first shrimp survey produced a by-catch assessment key (Abdulqader 1986). This key shows catch rates per species for 45 minutes fishing for each sampling month.

By-catch Assessment Program (February 1983 – January 1985)

This second study assessed by-catch taken by the industrial trawling fleet. This includes both shrimp and fish trawling. At that time, the industrial fleet was responsible for most by-catch generated by trawl fisheries. It is worth mentioning that at that time the reporting scheme had not yet been developed to include the artisanal sector which anyway started increasing significantly only in 1985. Industrial fishing boats were required to submit monthly reports on their fishing activities. Standard forms for both fish and shrimp fishing were provided to every fishing boat. In these reports, skippers were requested to report on their fishing activities on a daily basis. For the by-catch assessment program, an additional form was provided to the skippers. In this form, the skipper was to record on a daily basis, haul after haul, the target species (shrimp or fish), the weight of total catch, quantity of shrimp, fish block number and the weight of the by-catch per haul (the weight of small fishes was recorded in number of standard baskets).

Figure 11. Map showing the fixed stations trawled during the first shrimp survey conducted from June 1980 to June 1981

For by-catch estimation purposes, the entire fishing ground was divided into 10 nautical mile grids. This resulted in 182 grids.

One basket of small fish was randomly collected per fishing day. At the laboratory, these samples were sorted to the species level. Weights of each species in the samples were recorded. Species weight ratios of the sample were used to estimate the weights of these species in the total by-catch.

Data on fleet activities were provided in the standard fishing forms. The total number of hauls conducted in a month was estimated from these forms. Average by-catch weight per haul was used to estimate monthly total by-catch in each fishing block. Fishing effort was estimated in the same way.

Most of the calculations have been completed. The final report summarizing these data has not yet been written. Time and computer limitation prevented the full analysis of these data.

GCC (second) Shrimp Survey (March 99 to February 2001)

Under the Gulf Co-operative Council (GCC) umbrella, in March 99, Kuwait, Saudi Arabia, Bahrain and Qatar started to conduct a regional shrimp survey. This survey is on going and includes a monthly sample for two years. Each country is responsible for conducting the survey in their own waters at randomly selected grids. The shrimp area was divided into 3 miles grids. Each grid was defined by a unique alphanumeric code. All concerned countries adopted standard nets and fishing practices. Only commercial fishing boats are used in this survey.

For Bahrain, 57 fishing blocks were identified within the three main shrimp areas: west, north, and south (Figure 12). In each month, 50-60% of the fishing blocks are randomly selected. Each selected block is trawled once for 30 minutes. Sampling is usually conducted over three nights.

In addition to the data collected on shrimp, records are also kept on total weight of fish by-catch for each sampling block. Results for March, April and May 99 are presented in Appendixes 3, 4 and 5 respectively. Shrimp to fish by-catch ratio showed wide variation during these months from 1:0.2 (BG74, March 1999) to 1:150 (BL74 & BM73, April 1999).

## 9. SHRIMP HANDLING, AND PROCESSING

Bahrain shrimp fishing is a one-day operation. All shrimp landed are displayed as a fresh head-on product for local consumption and export. A shrimp auction is conducted daily at the Manama Central Market. Shrimp are usually displayed in 40 kg insulated boxes. The auction is held from 04:00 to 06:00 hrs daily.

During the shrimp season, shrimp are usually displayed as fresh heads-on. During the ban period, only frozen and processed shrimp are allowed for sale. Dried shrimp are sold throughout the year. Demand for dried shrimp increases during the ban period. Shrimp inflow, and wholesale and retail values for 1995 to 1997 are shown in Table 7.

**TABLE 7. Shrimp inflow, and wholesale and retail value (in million Bahrain Dinars) for the years 1995, 1996, and 1997 in Manama Central Market. (1 US$ = 0.378 Bahrain Dinar)**

| YEAR | INFLOW (TONNES) | WHOLESALE VALUE | RETAIL VALUE |
|---|---|---|---|
| 1995 | 1,811 | 2.9 | 3.4 |
| 1996 | 2,753 | 3.1 | 3.8 |
| 1997 | 1,924 | 2.8 | 3.4 |

Source: Fisheries Statistical Section, 1998a.

Shrimp wholesale and retail prices showed a decline with increase in landings from 1995 to 1997 (Table 8). Wholesale and retail prices ranged from Bahrain Dinars 1.241/kg to 1.855/kg and from Bahrain Dinars 1.555/kg to 2.157/kg respectively.

**TABLE 8. Shrimp landings, and wholesale and retail price (in Bahrain Dinars) for the years 1995, 1996 and 1997 in Manama Central Market. (1 US$ = 0.378 Bahrain Dinar)**

| YEAR | LANDING (TONNES) | WHOLESALE PRICE | RETAIL PRICE |
|---|---|---|---|
| 1995 | 1,662 | 1.855 | 2.157 |
| 1996 | 3,565 | 1.241 | 1.555 |
| 1997 | 2,571 | 1.626 | 1.891 |

Source: Fisheries Statistical Section, 1998a

For shrimp exports, frozen products increased between 1995 to 1997 (Table 9). Fresh shrimp were exported in 1995 and 1996. Most of fresh shrimp were exported to Saudi Arabia because of the early opening of Bahrain shrimp season. From the 1997/98 season, the Saudi shrimp fishing season started on the same date as the Bahrain season. This resulted in the saturation of the Saudi market and reduced Bahrain shrimp export. Fresh shrimp were not exported in 1997.

Frozen shrimp exports go mainly to the European market. Smaller amounts go to the Near East markets. At present, there are 5 processing plants operating in Bahrain. These plants are capable of producing frozen head-on or headless shrimp for export. Recently, the European Union released new health standards for fish products imported to EU countries. Bahrain shrimp exports are no longer allowed until local regulations are improved and inspection services become available.

Bahrain shrimp cannot be exported to the US markets. This is due to the shrimp import embargo enforced through the US public law 101-162. The law requires that nations or economies that export shrimp to the United States must receive from the department annual certification. There were shrimp exports from Bahrain to US markets in the 1970s, during the operation the BFC. Since that time, there have been no shrimp exports from Bahrain to US.

**TABLE 9. Shrimp landings, and wholesale and retail price (in Bahrain Dinars) for the years 1995, 1996, and 1997 in Manama Central Market**

| PRODUCT EXPORT/IMPORT | 1995 | 1996 | 1997 |
|---|---|---|---|
| Export – Fresh | 164 | 1,096 | - |
| Export – Frozen | 471 | 856 | 1,740 |
| Export – Dried | 13 | - | 599 |
| Import – Fresh | 89 | 1 | - |
| Import – Frozen | 72 | 28 | 50 |
| Import – Dried | 36 | 17 | 122 |

Source: Fisheries Statistical Section, 1996, 1997, 1998a.

## 10. REGULATIONS AND MANAGEMENT MEASURES

The Directorate of Fisheries (Ministry of Works and Agriculture) is the institution concerned with the management of the fisheries resources in Bahrain waters. This office was created by Amiri Decree Number 11 for the year 1979. The first industrial shrimp fleet was established in 1967.

The fishing law was declared in 1981. There have been no major changes to the law since that date. However based on this law, a number of ministerial decrees were issued subsequently to develop management procedures for fisheries resources. Many of these decrees related to the shrimp fishery.

A shrimp ban was first declared in 1980 (decree no. 26 for 1980). This decree set the ban period from 1 March to 30 June 1980, excluding a defined area within the southern ground. Decrees Number 16 and 17 for 1981 required fishing boats to be registered and licensed by the Directorate of Fisheries.

Decree Number 6 for the year 1986 established the minimum mesh sizes for several types of fishing gears used in Bahrain waters. For shrimp trawl, the minimum mesh size was set at 30 mm.

Decree number 15 of the year 1994 prevented issuance of new fishing licenses during 1995 and 1996. Decree Number 16 for the year 1994 required the presence of a Bahrain captain on the fishing boats.

In addition to the above decrees, several decrees were issued annually to set the start and the end of the shrimp seasons.

The current fishing decrees focus on three main area bases for managing Bahrain's shrimp fishery. First is the control of the number and size of fishing boats through a registration and licensing scheme. Second is protecting shrimp recruits by banning shrimp fishing during sensitive time periods. Third is increasing the selectivity of fishing nets by setting a minimum mesh size. Currently, there are no regulations on the use of the by-catch reduction devices (BRD) or turtle excluding devices (TED).

From 1985, the number of shrimp fishing boats has increased dramatically. At present there are about 400 boats ready to be involved in shrimp fishing. As such the licensing scheme has failed to control the fishing effort.

The GCC Fisheries Committee (fourth session, 3-4 October 1996) proposed an expansion of the shrimp fishing ban period to 6 months. The ministerial meeting in November 1996 approved this. For the unique social and economical conditions, Bahrain was excluded from the immediate enforcement of this regulation. In Bahrain the ban period was extended gradually from three to four months only. Further expansion of the ban period received strong opposition from Bahraini fishermen. The GCC countries had great concern about the non-implementation of the six months ban period. This matter will be discussed at a future ministerial meeting.

Bahrain fisheries suffer from inadequate enforcement of fishing regulations (Directorate of Fisheries 1993). This problem was defined as a major obstacle to developemnt of the Bahrain fisheries. In order to establish better control, surveillance, and management, the cabinet issued Decree Number 6 for the year 1997 to create a special committee to address and enforce fishing decrees. This committee includes officials from the Ministry of Works and Agriculture (Directorate of fisheries), Ministry of Information and Cabinet Affairs (television, radio, press), Ministry of Housing, Municipalities, and Environment (Environment Affairs, Municipalities), Ministry of Interior (Coast Guard Directorate), and the Ministry of Labour and Social Affairs.

The Fisheries Enforcement Committee initiated significant surveillance and control efforts during the 1997/98 shrimp ban period. This effort was still not enough to achieve full implementation of shrimp fishing regulations. Illegal shrimp fishing was again reported during the 1999 ban period.

Lower catch rates, longer trawling periods, and smaller shrimp sizes, are all indicators of over-fishing in the Bahrain shrimp fishery. In addition, the shrimp fleet contains a wide size range of boats. This includes small boats, which mainly operate on shallow waters, and big boats, which operate in deeper waters. This contracting fishing strategy prevents the proper management of the Bahrain shrimp fishery. The future management requirements should assure that all fishing boats should maintain the same fishing strategy. This can be achieved by setting the minimum and maximum size limits of the fishing fleet. This regulation excludes small boats, and consequently prevents catching small shrimp during the season.

To ensure protection of shrimp recruits, a ban area regulation might be considered. This regulation might prevent fishing and other destructive activities in specific areas. These areas should be determined as important shrimp nurseries. However, since enforcement is still inadequate, it would be difficult to secure and protect these sensitive nursery areas.

## 11. IMPACT OF SHRIMP FISHING ON MARINE ENVIRONMENT

In the case of Bahrain, the impact of shrimp fisheries on the marine environment and living resources have not been studied as a special topic. Several works have been conducted on the fisheries and marine environment. The assessment of impact of shrimp fisheries is based on these works and the opinion of the author.

Shrimp Resources

The common shrimp species *P. semisulcatus* showed a prolonged spawning behaviour in Bahrain waters (Abdulqader, 1995). This is also suggested by the appearance of shrimp recruits over a long time period. It is common to catch these recruits even during the fishing season by small boats. At present, there is no regulation to protect shallow nursery areas. Trawling in shallow areas may cause over-fishing of recruits. In addition, both *Metapenaeus stebbingi* and *M. kutchensis* females spawn in the shallow waters in April and May (Abdulqader, 1999). Fishing during the ban period in these areas will reduce the spawning stocks of these two species.

Shrimp trawlers are causing recruitment over-fishing of the main shrimp species, *P. semisulcatus*. This is suggested by low catch rates and smaller shrimp sizes observed from the on going GCC shrimp survey. Trawlers are likely to have less impact on the spawning stock of this species.

Ban area regulation may prevent fishing at shrimp nursery grounds. Small boats can be excluded from the shrimping fleet. These could provide further protection to shrimp recruits.

Fish Resources

Results of the first shrimp survey indicated the presence of more than 90 fish species in the shrimp by-catch (Abdulqader, 1986). Based on the occurrence score (see section 8), there were 11 species dominating shrimp by-catch: *G. oyena; Paramonachanthus* sp.*; P. stridens; S. taeniatus; U. tragula; L. lentjan; S. leptolepis; S. canaliculatus; N. bleekeri; R. haffara;* and *U. sulphureous*. The Rabbit fish; *S. canaliculatus* supports wire trap and gillnet fisheries. It contributed by 16% to the 1997 total fisheries landings. Also *L. lentjan,* and *R. sarba* are common species in the wire trap fishery. *G. oyena* are caught by the gillnet fishery.

The presence of the juveniles of commercially important fish species in the shrimp by-catch indicates an interaction between the shrimp trawls and the wire trap and gillnet fishery.

Shrimp trawls also result in mortality of the non-commercial fish species. This can alter the marine food web. In Bahrain waters shrimping activities are conducted in depths extending from 2 to 20 m. These shallow areas are probably the nursery grounds for many fish species found in Bahrain waters.

Shrimp trawling can reduce fish abundance. In addition to shrimp trawls, there are other fishing practices and gears used which negatively impact the marine environment in Bahrain waters. As such these can also contribute towards reduced fish catch rates. Fish trawlers can contribute in reducing fish catch rates. These trawlers operated in Bahrain waters since the 1970s, and continued to operate until 1998. A 3 month ban period was enforced only in 1997. Now, fish trawling is illegal in Bahrain waters.

Double and triple layered gillnets are illegal in Bahrain waters, but are still used. This non-selective gear is used in shallow and coral reef areas. It catches juvenile fish. The traditional gear, the barrier trap is still used in the coastal waters of Bahrain. If this gear is erected in nursery areas, it can catch large numbers of juvenile fish. Similarly, small mesh gillnets are frequently used to catch small rabbit fish.

Although the impact of shrimp trawls on reducing fish catch rates is considerable, it is difficult to relate this decline solely to shrimp trawlers. Other gear and unhealthy fishing practices also play a role. Increasing net selectivity by adopting BRD will reduce the impact of shrimp trawls on fish resources.

Marine Turtles

In Bahrain waters, turtles are incidentally caught in shrimp trawls. The magnitude of these incidences is difficult to assess especially as turtles are not landed for human consumption. Turtles caught are alive and just usually returned to the sea. The shrimp fishing logbook scheme provided a good opportunity for data collection on turtle incidence in shrimp trawls. Collection of turtle incidence data started with the 1997/98 shrimping season. Results of the 1997/98 season were completed and presented in Abdulqader (draft). Information provided below is based on this work.

From the 1997/98 shrimp season, an additional column was introduced into the shrimp fishing logsheet. In this column, fishermen were instructed to note down, on a daily basis, the number of turtles found in their catches. The 'X' symbol was used to indicate turtle absence. Since fishermen only use one local name for sea turtles, it was not possible to differentiate different turtle species.

In the 1997/98 season, there were 1,229 turtle incidences from 54,831 fishing days. Out of the 20 fished areas during the 1997/98 season, turtles were found only in 12 of these grounds (Figures 4 and 13). The "Umudood" area received most of the fishing effort and was the second highest in turtle incidence. The highest turtle incidence was found in "Qumais" fishing area, which had the second highest amount of fishing effort.

Turtles were not found in the western grounds, including Aleslah and Khur Fasht areas (Figures 4 and 13). Turtles were also not found in other areas, including Buoy 25, Jaradah, Mina Sulman, Jaw, Ras Albar, Umalnaisan, and Tibab.

The highest number of turtle incidences and fishing effort were in October 1997 (Figure 14). Turtle incidence declined in the following months and were at the minimum by February 1998 (Figure 14). Fishing effort also shows a similar declining trend during these months but by a smaller magnitude. Turtles were found in the shrimping ground throughout the season.

In Bahrain, there is no regular coastal monitoring of sea turtles stranded. The public usually reports the presence of dead animals to the concerned authority. A few reports on stranded turtles are usually received at different times during a year. If the shrimp fishery is responsible for these mortalities, high numbers of dead turtles should be found during October, when the highest incidence rates occur. Caillouet *et al.* (1991) detected a significant correlation between stranded turtles and shrimping in the Northwestern Gulf of Mexico shrimp fishery. They concluded that this correlation does not demonstrate that shrimp fishing was the cause of stranded turtles.

Crab

The Bahrain crab fishery is based on a single species, *Protunus pelagicus.* Crabs are traditionally collected by hand from shallow coastal areas or by the inter-tidal barrier trap. Recently, shrimp trawls (Fisheries Statistical Section 1997, 1998b) produce about 95% of crab landings. Crab landings increased from 1985 to 1997 (Figure 12). By the end of the shrimping season, crab catches usually compensate for the decline in the shrimp catches.

Shrimp trawls operated in shallow waters may catch a considerable amount of juvenile crabs. Intensive operation in these areas may cause recruitment over-fishing. Buried females are usually found in deeper waters. In the GCC shrimp survey, buried females were abundant in March 99. Buried crabs declined gradually in the successive months reaching the lowest percentage in August 99. In Bahrain, present regulations do not ban catching and marketing the buried females. Increase in shrimp fishing effort will likely reduce the number of the buried females. Crab landings (Figure 15) did not indicate that the present level of shrimp fishing caused over-fishing of crab stocks.

Other Fauna

The shovelnose lobster, *Thynus orientalis,* is common in shrimp by-catch. This species was found in fish trawls in good quantities during the period October to January. Up to almost 200 tonnes of shovelnose were landed in a year (Fisheries Statistics Section 1998a).

The mantis shrimp, *Squilla* sp., is another crustacean found in shrimp by-catch. This species is not caught in other gears, and does not support any fishery in Bahrain. This species is not consumed locally.

Toward the end of the shrimp season, Cuttlefish *Sepia* sp., are usually caught in good quantities. Their quantities may surpass shrimp catches during this period. Cuttlefish eggs are usually caught in shrimp by-catches.

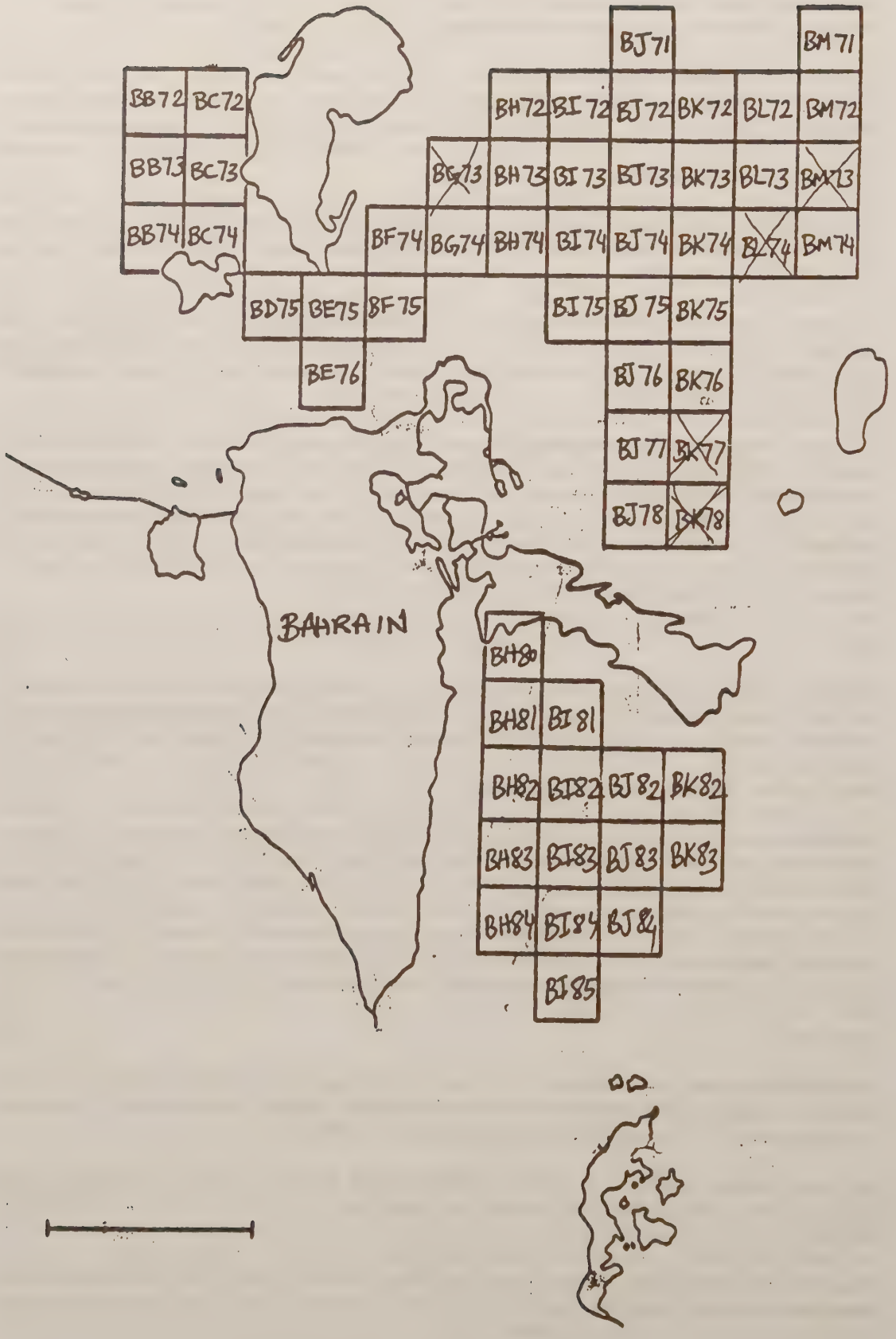



**Figure 12. Sampling grids defined within the Bahrain waters for the use of the GCC shrimp survey. The alphanumeric codes are shown per grid.**

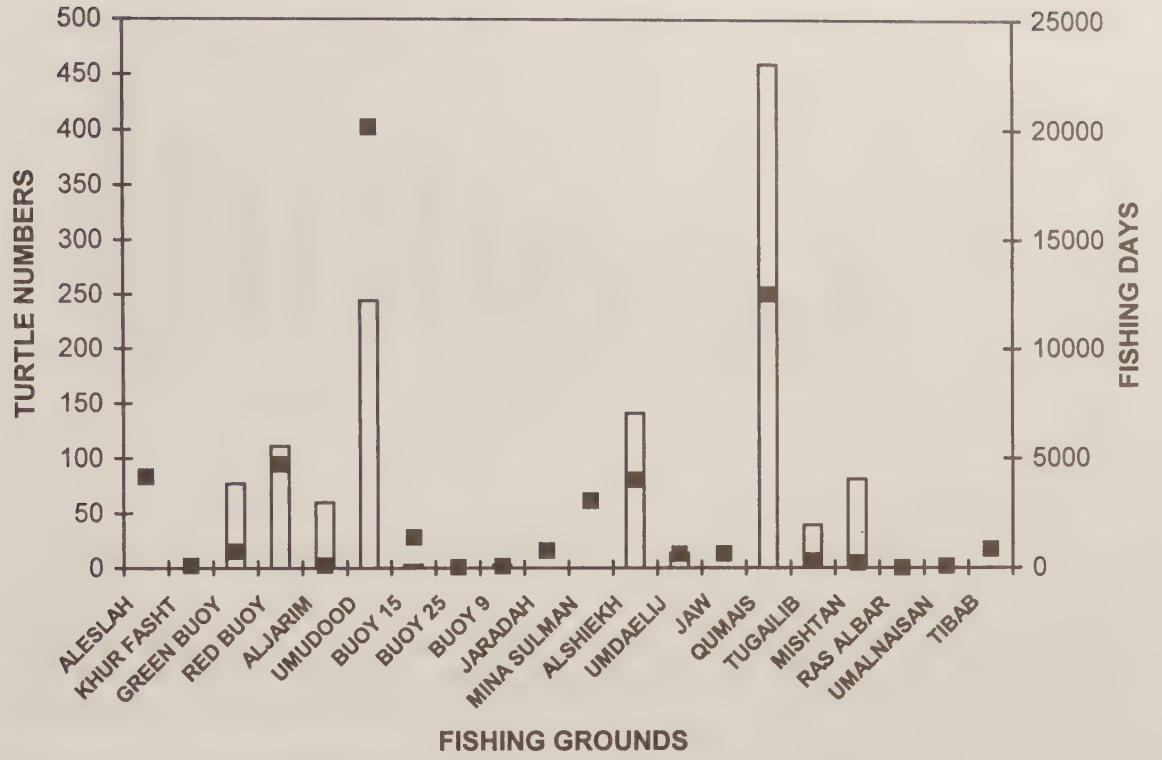



**Figure 13. Total turtle incidences in shrimp trawl (bars), and total fishing days per fishing ground (square) during the 1997/98 shrimping season**

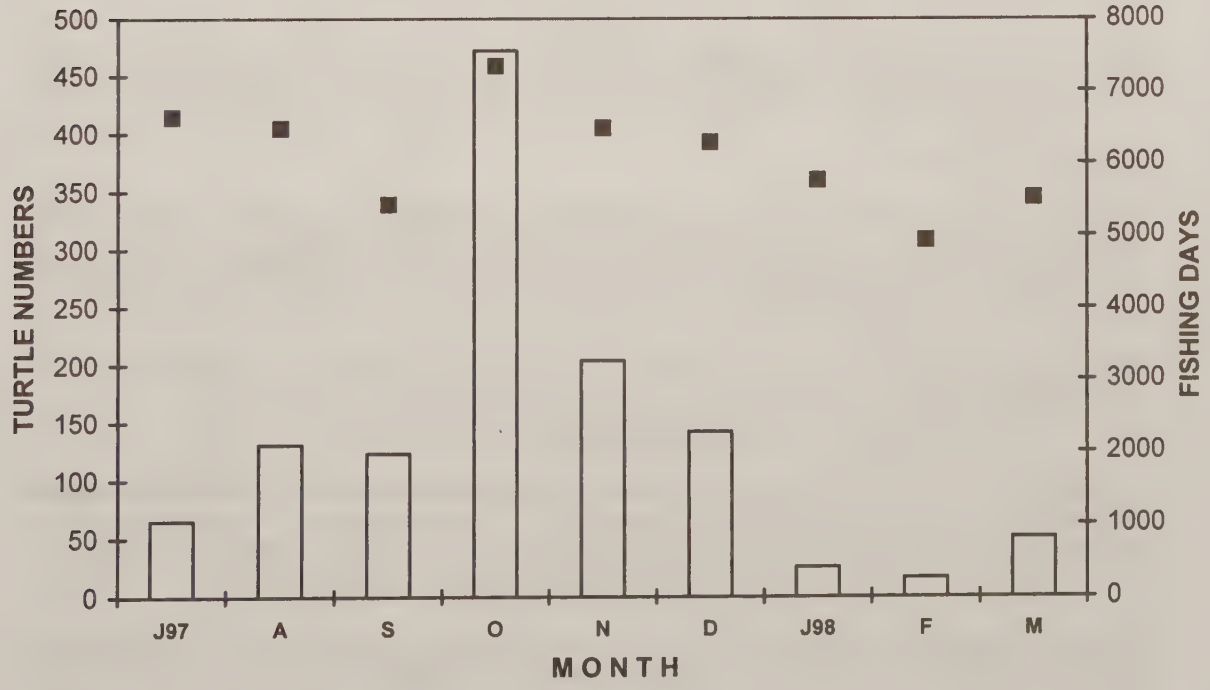



**Figure 14. Total monthly turtle incidences (bars), and total fishing days (square) during the 1997/98 season, aggregated for all fishing areas**

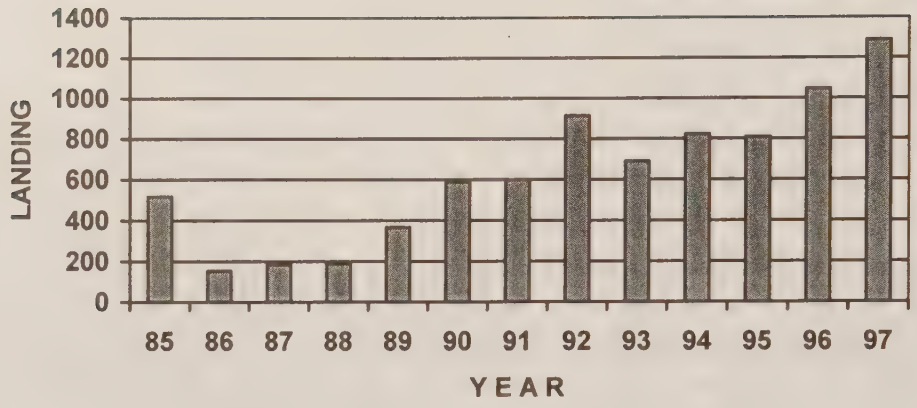



**Figure 15. Total crab landings for 1985 to 1997 (Fisheries Statistical Section, 1998a)**

Discards from shrimp trawls are used as food by sea gulls and dolphins. Large numbers of sea gulls are usually seen during the fishing season chasing shrimp trawlers. These birds are not found in similar abundance during the ban period. The shrimp provides easy food for both sea gulls and dolphins, and accordingly enhanced their populations.

Bottom Habitat

Shrimp trawls impact the seabed. The direct contact of the gear will damage and destroy algae and sea grass. Also, it can break and remove corals. Operation of the gear generates silt in the water column. Settlement of the silt on coral and other sensitive habitat can suffocate these areas.

## 12. RESEARCH ACTIVITIES

In this sections only fisheries research activities are highlighted. These include, shrimp trawl selectivity, Spanish mackerel fishery, shrimp fishery, crab fishery, and shovelnose lobster fishery.

Shrimp Trawl Selectivity

Increasing shrimp trawl selectivity is an important solution to minimize fish by-catch. Fish catch rates in Bahrain waters are generally low. Waste from shrimp trawls commercial by-catch may be contributing in decreased fish catch rtaes. The aim of this research was to develop By-catch Reduction Device (BRD) for Bahrain shrimp fishery.

Initial experiments concentrated on evaluating square mesh as a means of reducing fish by-catch (Abdulqader and Mansoor, 1996). These experiments had encouraging results (Appendix 6). There was also a smal reduction in fish by-catch when mamals were in trawl catches.

A rigid grid was developed to exclude big mamals and to facilitate the escape of small fish. The Radius Square Mesh (RSM) was used instead of Square Mesh (SM). Escape areas for small fish and big mamals were covered by collecting bags. All mamals which escaped from the nets were collected in these bags. The prelimanery results of these experiments were encouraging (Table 10).

Further experiments were conducted by covering areas of escape of small fish and big mamals. The aim of these experiments was to set the specification of the Bahrain BRD.

In February 1999 a new research project on BRDs was started. This programme aimed to test the BRD with seasonal variations in fish abundance and change in the physical properties of sea water. This programme will continue until January 2000.

**TABLE 10. Species/group, percentage escape in number from the BRD experimented on 18 August 1997. Numbers in brackets indicates number of species**

| SPECIES (numbers) / GROUP NAME | % ESCAPED |
|---|---|
| *Lethrinus sp.* (3) | 15.4 |
| *Siganus canaliculatus* | 71.4 |
| *Gerres sp. (3)* | 30.8 |
| *Rhabdosargus haffara* | 48.9 |
| *Upeneus sulphureus* | 23.2 |
| *Nematalosa nasus* | 11.1 |
| *Scomberomorus commerson* | 12.5 |
| *Scolopsis taeniatus* | 36.8 |
| *Alepes melanopetra* | 63.6 |
| *Selar crumenophthalmus* | 76.5 |
| *Arius thalassinus* | 43.8 |
| *Carangidae (7)* | 38.9 |
| Other sp. (14) | 49.0 |
| *Sepia sp.* | 31.6 |
| *Protunus pelagicus* | 1.7 |

In this study, two trials are conducted each month. Since Bahrain shrimp trawlers use only one net, two commercial boats were required so that catches between the conventional net and a net equipped with the BRD could be compared. Each trial lasted one night. Four 2 hr trawls were normally conducted. Trawls were conducted at 3.5 knots mainly in straight line path.

The catch is sorted into shrimp, crab, small fish, big fish (> 30cm total length) and small shrimp (found in abundance in certain months). From the first trawl, carapace length was measured for a random sample of 3 kg of shrimp (only *P. semisulcatus*) from both boats. Total numbers, and weights of shrimp are recorded for each haul in all boats. Similarly, total number and weight of crab catches are recorded. If total small fish catch is around 40 kg, the entire catch was collected to determine species composition. In cases of higher catches, 30 kg samples were randomly collected. Total weight of small fish was recorded. For big fish, lengths and total weight were recorded for each species. In addition, the presence of sea turtles and any significant remarks were recorded.

Shrimp Fishery

The GCC fisheries committee (fourth session, 3-4 October 1996) recognised the necessity to manage the shrimp resources at a regional level. A standard regional survey was proposed for the collection of the information required for regional shrimp management. This survey was important for countries with a shrimp fishery. These countries include: Bahrain, Kuwait, Saudi Arabia and Qatar.

This survey is conducted monthly for a period of two years. Sampling was started in March 1999. The sea area was divided into 3-mile grids. Each grid is defined by a unique alphanumeric code. Each country is responsible for conducting sampling in their waters.

Within Bahrain waters, 57 fishing blocks were identified for this survey (Figure 12). Each month, about 50-60% of the fishing blocks are randomly selected. Each selected block should be trawled once for 30 minutes. Sampling is usually conducted during three nights.

Different data types are collected during the survey. These include records on the fishing location, towing speed, sampling times, temperature and salinity of the surface and bottom, shrimp weight, fish by-catch weight and weight of small shrimp. Small shrimp are abundant during certain months. In addition, 3 kg shrimp samples were collected from each block. In the laboratory, samples are sorted into species, and further to sex level. Carapace length and maturity stages (in case of females) were recorded for three main species, i.e. *P. semisulcatus, P. latisulcatus,* and *M. kutchensis*.

Spanish mackerel fishery

For its migratory behaviour, Spanish mackerel (*Scomberomorus commerson*) received considerable attention from the GCC fisheries committee. A standard sampling programme was developed, particularly after observing a general decline in landings.

The spanish mackerel programme is based on concurrent sampling of Spanish makerel landed along the whole GCC sea area. This sampling follows standard procedures and practices. The sea area of this programme extends from Kuwait at the Arabain Gulf, across the Gulf of Oman, to Salalah at the Arabian Sea..

The programme proposed that an experimental period shoud precede full adoption of the programme. The experimnetal phase will allow countries to evaluate and amend this programme. This phase lasted for 12 months from November 1997 to October 1998. Along the GCC coasts, 15 landing sites were considered for this programme. The number of sampling sites was determined according to the length of their coastline. One site was determined for Kuwait, Bahrain, and Qatar, two sites in Saudi Arabia, four in UAE, and six in Oman.

At the end of the experimental phase, a regional workshop was organized in Bahrain from 28 November to 2 December 1998. In this workshop, data of the experimental phase were collected and analyzed. Based on these data, the first publication on the GCC Spanish mackerel fisheries was prepared (Abdulqader *et al.*, 1999). This workshop agreed on the extension of this programme to make it continuous or the development of a special computer programme to handle the data of the next phase.

Shovelnose Lobster Fisheries

Shovelnose lobster (*Thennus orientalis*) is usually found in abundance in fish trawling grounds from October to April. Fish trawlers landed up to 200 tonnes of shovelnose per year (Fisheries Statistical section, 1998a). From 1998 onward, fish trawling was prohibited in Bahrain waters. Besides the long term benefits derived from this regulation, the ban also caused the loss of the shovelnose fishery. The aim of the research on shovelnose was to test the viability of using traps to catch shovelnose lobster. Using traps is not practised in any part of the world.

Five trap designs will be tested under experimental conditions at the National Mariculture Centre (NaMaC). Also different types of bait will be tested. These experiments will start in October 1999.

Crab fishery

Bahrain's crab fishery is now being researched with the co-operation of the Unversity of Wales, UK. This programme will provide a detailed description of crab life cycle in Bahrain waters. This information is essential for management of this fishery. Sampling started in March 1999. It will continue monthly until March 2000. Shrimp trawls, gillnets, and plankton nets are being used to sample different crab life stages in the shallow coastal and offshore deeper areas.

## 13. PERCEPTION OF THE PRESENT SITUATION REGARDING SHRIMP EXPLOITATION AND ENVIRONMENTAL IMPACTS

This section is based on the findings of the opinion survey (Uwate and Abdulqader, 1999, Appendix C) conducted during the current GEF/UNEP/FAO project. Perception of shrimp fishing and its impact on the environment were documented for different sectors. This includes the views of: 1) the shrimp fishing industry; 2) other fishermen; 3) environmental groups; and 4) fish traders.

Shrimp Fishing Industry

Shrimp fishermen were the main target group of this opinion survey. Shrimp fishermen disagree with 8 problems outlined in the questionnaire. They only agree (70%) that Bahrain shrimp fishery faces a problem of increase in fishing effort. To reduce the fishing effort, they favoured reduction in the number of fishing boats (84%), restrictions on fishing gear (83%), and improvement of the efficiency of fishing gear (78%). They also agree (75%) to change fishing practices to target other species. They

did not favour introduction of the BRD (72%), implementing closed area regulations (72%), and the use of another gear in shrimp fishing (75%).

Other Fishermen

Other fishermen considered any reduction in fish by-catch would be beneficial to fish resources. They agreed that the important problems are: catching fish (75%) and shrimp (75%) juveniles, and damaging the seabed (68%). They agree that poor knowledge (62%) and poor management of the shrimp fishery (69%) are fisheries management problems. To reduce the fishing effort, they agreed with 1) improved Monitoring, Control, and Surveillance MCS (91%); 2) restricted fishing in certain season (81%); 3) introducing limitation on fishing gear (72%); 4) implementing closed areas (70%); and 5) reducing the number of fishing boats (68%).

To increase fish and shrimp stocks, they agreed (84, and 86 %) with the introduction of BRDs, and the establishment of closed areas (73, and 84%) respectively. To minimize the damage to the seabed, they agreed with the reduction of bottom contact of shrimp trawls (81%), and replacing trawling with alternative methods (68%).

In order to increase knowledge of the shrimp and fish stocks, 88% of the respondents agreed that more fisheries research was necessary and fishermen should provide more information (72%). To solve poor management, 88% of the responses agree that national priority should be given to fishery research, 79% agreed that the fishing industry and other stakeholders should participate in management decisions.

Environmental groups

The number of respondents from this group was small (6). Responses agreed (83%) that damage to the seabed, poor knowledge on shrimp stocks, and poor management were main fisheries problems. They agree that reducing gear contact (83%), and replace trawling were main issues to minimize damage to the seabed. Most (83%) agreed that increased research on shrimp and fish stocks was needed, and that fishermen should provide more information in order to increase knowledge on shrimp and fish stocks. They agree (83%) that fisheries research should be a higher national priority so fishery management could be improved.

Fish Traders

Fish traders agreed that damage to seabed (80%), poor management (75%), poor knowledge (69%), reduced catch rates (63%), and catching juvenile shrimp (61%) are the significant problems in Bahrain's fisheries. Respondents (81%) indicated that seabed damage could be reduced by decreasing bottom contact of gear, and by replacing trawling with another fishing method. They agree that higher national priority should be given to fishery research and the fishing industry should be involved in management decisions. To increase knowledge on shrimp and fish stocks, all interviewed fish traders agreed that fishery research needs to be increased, and that fishermen should collect more information.

To increase catch rates, 94% agreed that MCS should be improved. Most (89%) agreed to introduce of restrictions on fishing gear, restrict fishing in certain seasons (82%), change target species (77%), and improve gear efficiency (77%). To decrease juvenile shrimp in the catches, 91% agree that size selection devices be introduced, 82% agreed that trawling should be banned when juvenile shrimps were abundant, and 73% agreed that areas be closed when there was a large amount of juvenile shrimp present.

## 14. NATIONAL IDENTIFICATION OF PRIORITY ISSUES REQUIRING ACTIONS TO MEET ACCEPTABLE STANDARD OF ENVIRONMENTALLY FRIENDLY SHRIMP EXPLOITATION

In Bahrain's fisheries certain preferred species have declining catch rates over a relatively long period. Solving this problem is an objective of fisheries management. Several factors may play a role in this decline and the future plans for the development of fisheries resources should be based on the principle of responsible fishing. At this time there is no official fisheries management plan. Any proposed Bahrain plan for fishery development should give priority to by-catch, unhealthy gear and fishing

practices, and the over-fishing problems. These management requirements cannot be implemented in the absence of effective monitoring, control, and surveillance efforts.

Protection of the Nursery Areas

At present, shrimp fishing in Bahrain is not restricted to water of certain depths. Except for the shrimp ban period, fishing can be practised at any time and in any area regardless of the depth. Shrimp fishing causes damage to the marine environment. The magnitude of this damage will vary according to the fishing gear used, and the sensitivity of the area. Shrimp fishing will have greater impact if conducted in shallow waters, which can be nursery grounds for small fish.

Abdulqader and Naylor (1995) suggested that important shrimp nursery areas are found in the shallow water areas south of Fasht Al-Adhom. These waters also may be the spawning ground for *M. stebbingi* and *M. kutchensis* (Abdulqader 1999). Therefore, it is important to protect these shallow waters against fishing operations and other human activities. A distance of 1 mile from the coast or from coral reefs may be an appropriate distance.

Protection of the Recruits

At present the shrimp ban period extends for 4 months. It usually starts on 1 April and ends on 1 August. This ban period was implemented to protect shrimp recruits. For proper management, this period should be extended to six months. First September is the ideal date for starting the fishing season. Low catch rates and a high percentage of small shrimp were observed in August catches in 1998 and 1999. Also small shrimp are usually caught in March in shallow waters by small boats. This indicates that during the present fishing season, shrimp recruits are still caught in significant numbers.

To achieve adequate protection of shrimp recruits, it is necessary to extend the shrimp ban period to six months. Both March and August should be included in the ban period. The GCC Fishery Committee also proposed a similar time period for the shrimp ban period.

Stop New Shrimp Fishing Licenses

Over capacity is a major problem in the Bahrain shrimp fishery. The number of fishing boats increased from 26 to about 400 between 1976 and the present time (1999). The increase in the number of fishing boats has resulted in less catch per boat. This is creating difficult economic conditions for these boats. During bad seasons, several boats were unable to continue and were forced to leave the fishery. The present number of boats exceeds the potential of the stock. According to Abdulqader (1995) 73 full time boats are enough for this fishery. The first step toward reducing the number of boats is to stop issuing new shrimp fishing licenses.

Fishing Gear and Boat Limitation

Introduction of winches allowed the use of larger trawl nets. In some cases, nets up to 25 fathoms (foot rope) are used. There is no restriction on the net size used in the shrimp fishery. Similarly, there is no restriction on the size of the shrimp boat.

Bahrain shrimp fishery suffers from extremely high fishing effort and recruitment over-fishing. Any development plan should set 1) an upper size limit for trawl nets, and 2) lower and upper size limits for the shrimp fishing boat.

Increasing Net Mesh Size

Increasing mesh sizes may contribute towards increasing net selectivity. Increasing mesh sizes will also reduce the resistance of the nets during operation. This will be economically beneficial to the fishing boat. The present minimum mesh size (30 mm) is relatively small. For the future, the increase of minimum size to at least 40 mm should considered

Implementation of BRD

The present experiments proved that the use of the BRD in the Bahrain shrimp fishery would be beneficial to the fishery and the marine environment. These benefits need to be highlighted and demonstrated to the fishermen. These benefits included: 1) reducing the sorting time; 2) improving shrimp quality; 3) maintaining net efficiency for a longer period; and 4) maintaining the bio-diversity of the environment. Demonstrating these benefits will convince fishermen to adopt the BRD.

For successful BRD adoption by shrimp fishermen, it is important that they believe in its importance. They should understand the operation concepts of the BRD and should be able to handle problems arising from use of the device. An extension programme should be initiated to demonstrate the necessity of the device to achieve responsible fishing. Also fishermen need training on how to make the device and how to solve problems that may arise from using it. Training also will be required for the Coast Guards who should focus on legal specifications of BRDs, and procedures to verify these specifications.

## ACKNOWLEDGMENTS

I would like to express my gratitude and appreciation to Dr. Roger Uwate Adviser Directorate of Fisheries, for his review to the first draft of this document.

**LITERATURE CITED**

Abdulqader, E. A. A. 1982. The impact of the close season on the shrimp fishery in Bahrain. In Appendix11, pp. 69-76, in FAO 1982, Assessment of the shrimp stocks of the West Coast of the gulf between Iran and the Arabian Peninsula. FI:DP/RAB/80/015, pp.163.

Abdulqader, E. A. A. 1983. Review of the statistical system adopted by the Directorate of Fisheries (Bahrain), Directorate of Fisheries, Ministry of Commerce and Agriculture, Technical Circular No. 16.

Abdulqader, E.A.A., 1986. Study of by-catch generated by shrimp trawling in Bahrain waters. M.Sc. Thesis, University of Wales, U.K., pp. 98.

Abdulqader, E.A.A., 1988. A trial to introduce a reporting scheme for data collection of the artisanal shrimp fishery in Bahrain. Ministry of Commerce and Agriculture (Bahrain), Directorate of Fisheries, Technical Circular No. 33, pp. 9.

Abdulqader, E.A.A., 1995. Fisheries and aspects of the biology of penaeid shrimps of Bahrain. Ph. D. Thesis, University of Wales, U.K, pp. 195.

Abdulqader, E.A.A. and Naylor, E., 1995. Bionomics and migration patterns of the green tiger prawn, *Penaeus semisulcatus* De Haan, in Bahrain waters. Fisheries Research, 12:395-407.

Abdulqader, E.A.A. and Mehic, N., 1996. Development of GIS for Bahrain shrimp fisheries management. Sixth International Conference on Computer Theory and Applications, 3-5 September 1996, Alexandria, Egypt, pp. 361-366.

Abdulqader, E.A.A. and Mansoor, J., 1996. Preliminary results of shrimp trawl selectivity experiments in Bahrain. In Yimin Ye and AlMatar, Proceedings of the meetings of the working group on shrimp and other invertebrates and working group on demersal fishes and marine habitat, Kuwait, 11-13 May 1996, pp. 106-110.

Abdulqader, E.A.A., 1999. The role of shallow waters in the life cycle of the Bahrain penaeid shrimps. Estuarine, Coastal and Shelf Sciences, 49 (Supplement A) pp. 115-121.

Abdulqader, E.A.A.; AlMuameri, J.M.; AlMuhammedi, J.S.; Fita, N.E.; AlZaroni, M.A. and AlMubarak, K.A., 1999. Spanish mackerel fisheries in the GCC waters – report on the experimental phase of the standard program to monitor Spanish mackerel landings in the waters of the GCC countries. Bahrain Center for Studies and Research, GCC General Secretary, pp. 45.

Abdulqader, E.A.A. (draft). Turtle incidences in shrimp trawl nets during the 1997/98 shrimp season in Bahrain waters. (Submitted to Asian Journal of Fisheries).

Boerema, L.K. and Job, T.J., 1968.The state of shrimp and fish resources in the gulf between Iran and the Arabian peninsula. IOFC, first session, Italy, 16-12 September 1968, IOFC/68/INF.11, pp.16.

Boerema, L.K., 1969. The shrimp resources in the gulf between Iran and the Arabian Peninsula. FAO Fisheries Circular No. 310, pp. 29.

Caillouet Jr, C.W.; Duronslet, M.J.; Landry Jr.; A.M., Revera, D.B.; Shaver, D.J.; Stanley, K. M.; Heinly, R.W. and Stabenau, E.K., 1991 Sea turtle strandings and shrimp fishing effort in the North-western Gulf of Mexico, 1986-89. Fishery Bulletin, U.S., 89:712-718.

Directorate of Fisheries, 1993. Survey of fishermen in Bahrain. Ministry of Commerce and Agriculture, Bahrain, pp. 27.

FAO, 1978. Fisheries biologist - shrimp - Bahrain - project findings and recommendations. FI:DP/BAH/74/017, pp. 58.

FAO, 1973. Report of the first session of the Indian Ocean Fishery Commission – special working party on stock assessment of shrimp in the Indian Ocean area. FAO Fisheries Reports No. 138, pp. 40.

Fisheries Statistical Section, 1997. Fisheries statistics for the first half of year 1997. Technical CircularNo. 68, Directorate of Fisheries, Ministry of Commerce and Agriculture.

Fisheries Statistical Section, 1998a. Annual statistics report – 1997. Technical Circular No. 70, Directorate of Fisheries, Ministry of Commerce and Agriculture, pp. 90.

Fisheries Statistical Section, 1998b. Fisheries statistics for the second half of year 1997. Technical Circular No. 69, Directorate of Fisheries, Ministry of Commerce and Agriculture.

Uwate, R.; Abdulqader, E.A.A., 1999. Interaction of the Bahrain shrimp trawl fishery with the marine environment: An opinion survey. GEF/UNEP/FAO Project on Reducing the Impact of Tropical Shrimp Trawling Fisheries on Living Marine Resources through the Adoption of Friendly Techniques and Practices, pp. 33.

**Appendix 1. Logbook sheet used by the shrimp trawl fishermen to report on their daily operation. Additional column was added in 1997 to report turtle incidence**

MINISTRY OF WORKS & AGRICULTURE
DIRECTORATE OF FISHERIES

وزارة الأشغال والزراعة
إدارة الثروة السمكية

Name of the Boat اسم السفينة _____

Name of the Owner اسم المالك _____

License No رقم ترخيص صيد الربيان _____

Tel. Number رقم الهاتف _____

تقرير عن صيد الربيان لفترة إسبوعين Fortnightly Report
من From / /
الى To / /
( اليوم / الشهر / السنة )
(Year/Month/Day)

| التاريخ اليوم / الشهر Day/Month | منطقة الصيد Fishing Area | عدد مرات تنزيل الشبك No. of times net lowered | معدل بقاء الشبك تحت الماء Average Duration of the haul | كميات المصيد على حسب الأنواع مقدرة بالكيلو جرام Catch by species in Kg. | | | | | | | | | فرضة الإنزال Landing Site | ملاحظات Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ربيان Shrimp | قبقب Crab | ام الربيان Lobester | ثلثاق Khalthag | باسع Basej | مسلق Museileq | حاسوم Hasoom | | عدد السلاحف Turtles No. | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

في حالة وجود السلاحف الرجاء ذكر العدد المسجل في اليوم الوارد
في حالة عدم وجود السلاحف في المصيد الرجاء وضع إشارة X
لكل يوم.
يرجى تعبئة النسخة الأصلية (البيضاء) أولا شخصياً وإلا من
خلال البريد على العنوان المذكور.

If Turtles are found in the catch, please record their numbers. If they are not found, please insert "X" symbol for each day.

Send the original (white) copy either personally or by post to the address mentioned.

Name الاسم _____

Signature التوقيع _____

**Appendix 2. Scientific names and corresponding family or group names of by-catch species found in shrimp trawl during the first shrimp survey from June 1980 to June 1981**

| FAMILY / GROUP NAME | SCIENTIFIC NAME |
|---|---|
| Triacanthidae | *Pseudotriacanthus strigilifer* (Cantor, 1849) |
| Lethrinidae | *Lethrinus lentjan* (Lacepede, 1802) |
| | *L. nebulosus* (Forsskal, 1775) |
| | *Lethrinus sp.* |
| Carangidae | *Seriolina nigrofasciata* (Ruppell, 1829) |
| | *Selaroides leptolepis* (Cuyvier, 1833) |
| | *Selar crumenophthamus* (Bloch, 1793) |
| | *Scomberoides commersonianus* (Lacepede, 1802) |
| | *Trachurus indicus* (Nekrasov, 1966) |
| | *Alepes sp.* |
| | *Carangoides bajad* (Forsskal, 1775) |
| | *Carangoides sp.* |
| | *Gnathanodon speciosus* (Forskal, 1775) |
| Gerreidae | *Gerres oyena* (Forskal, 1775) |
| | *G. filamentosus* (Cuvier, 1829) |
| Tetraodontidae | *Chelonodon patoca* (Hamilton-Buchanan, 1822) |
| | *Arothron stellatus* (Bloch and Schneider, 1801) |
| Synodontidae | *Saurida undosquamis* (Richardson, 1848) |
| | *S. tumbil* (Bloch, 1795) |
| | *Trachinocephalus myops* (Bloch and Schneider, 1801) |
| Nemipteridae | *Scolopsis taeniatus* (Ehernberg in Cuvier and Valenciennes, 1830) |
| | *S. ghanam* (Forsskal, 1775) |
| | *Nemipterus bleekeri* (Day, 1875) |
| Teraponidae | *Terapon puta* (Cuvier, 1829) |
| | *T. theraps* (Cuvier, 1829) |
| | *Pelates quadrilineatus* (Bloch, 1790) |

| FAMILY / GROUP NAME | SCIENTIFIC NAME |
|---|---|
| Monacanthidae | *Paramonacanthus choirocephalus* (Bleeker, 1852) |
| | *Stephanolepis diaspros* (Fraser-Brunner, 1940) |
| Pegasidae | *Pegasus natans* (Linnaeus, 1766) |
| | *Pegasus sp.* |
| Sparidae | *Rhabdosargus haffara* (Forsskal, 1775) |
| | *Acanthopagrus bifasciatus* (Forsskal, 1775) |
| | *Argyrops spinifer* (Forsskal, 1775) |
| | *Diplodus sargus kotschyi* (Steindachner, 1876) |
| | *D. noct* ((cuvier & Valenciennes) |
| Apogonidae | *Apogon bifasciatus* (Ruppell, 1838) |
| | *Cheilodipterus arabicus* (Gmelin, 1788) |
| Ariidae | *Arius thalassinus* (Ruppell, 1837) |
| Mullidae | *Upeneus sulphureus* (Cuvier, 1829) |
| | *U. tragula* (Richardson, 1845) |
| | *U. asymetricus* (Lachner) |
| | *Parupeneus heptacanthus* (Lacepede, 1802) |
| | *Parupeneus sp.* |
| Blennidae | *Petroscirtes ancylodon* (Ruppell, 1838) |
| Leiognathidae | *Leiognathus equulus* (Forsskal, 1775) |
| | *L. bindus* (Valenciennes, 1835) |
| Sillaginidae | *Sillago sihama* (Forsskal, 1775) |
| Clupeidae | *Nematolosa nasus* (Bloch, 1795) |
| | *Sardinella sp.* |
| Bothidae | *Pseudorhombus arsius* (Hamilton and Buchanan, 1822) |
| | *Bothus pantherinus* (Ruppel, 1830) |
| Scombridae | *Scomberomorus commerson* (Lacepede, 1802) |
| | *Rastrelliger kanagurta* (Cuvier, 1817) |
| Mugiloididae | *Parapercis ??* |

| FAMILY / GROUP NAME | SCIENTIFIC NAME |
|---|---|
| Platycephalidae | *Platycephalus indicus* (Linnaeus, 1758) |
| | *P. tuberculata* (Cuvier, in Cuvier and Valenciennes, 1829) |
| Lutjanidae | *Lutjanus fulviflammus* (Forsskal, 1775) |
| | *L. ehrenbergi* (Peters, 1869) |
| | *L. malabaricus* (Bloch and Schneider, 1801) |
| | *Lutjanus sp.* |
| Siganidae | *Siganus canaliculatus* (Park, 1797) |
| Callionymidae | *Callionymus persicus* (Regan, 1905) |
| Pomacanthidae | *Pomacanthus maculosus* (Forsskal) |
| Pomacentridae | *Dascyllus trimaculatus* (Ruppell, 1829) |
| | *Pomacentrus trichourus* (Gunther, 1866) |
| Echeneididae | *Echeneis naucrates* (Linnaeus, 1758) |
| Syngnathidae | *Hippocampus kuda* (Bleeker, 1852) |
| Labridae | *Gastrophysus lunaris* (Bloch & Scneider) |
| Sphyraenidae | *Sphyraena obtusata* (Cuvier, 1829) |
| | *S. jello* (Cuvier, 1829) |
| | *Sphyraena sp.* |
| Gobiidae | *Amblygobius albimaculatus* (Ruppell, 1930) |
| | *Cryptocentrus lutheri* (Klausewitz, 1960) |
| Plotosidae | *Plotosus linatus* (Thunberg, 1787) |
| Soleidae | *Euryglossa orientalis* (Bloch & Schneider, 1801) |
| | *Aesopia cornuta* (Kaup,1858) |
| | *Solea bleekeri* (Boulenger, 1898) |
| Dactylopteridae | *Dactyloptena orientalis* (Cuvier, 1829) |
| Scorpaenidae | *Apistus carinatus* (Bloch & Schneider, 1801) |
| | *Pseudosynanceia melanostigma* (Day, 1878) |
| | *Synanceia nana* (Eschmyer & Rama Rao, 1973) |
| Chaetodontidae | *Halichores sp.* |

| FAMILY / GROUP NAME | SCIENTIFIC NAME |
|---|---|
| Serranidae | *Epinephelus suillus* (Valenciennes in C. & V., 1828) |
| Batrachoididae | *Batrachus grunniens* (Linnaeus, 1758) |
| Rachycentridae | *Rachycentron canadus* (Linnaeus, 1776) |
| Engraulidae | *Thryssa sp.* |
| Ephippididae | *Platax tiera* (Forsskal, 1775) |
| Haemulidae | *Pomadasys stridens* (Forsskal, 1775) |
| Sharks & Rays | |
| Crab | *Protunus pelagicus* |
| Sand Lobster | *Thynus orientalis* |
| Cuttlefish | *Sepia sp.* |
| Mantis shrimp | *Squilla sp.* |

**Appendix 3. Results from GCC shrimp survey of shrimp catches (kg), fish by-catch weight (kg), and shrimp to fish by-catch ratio in March 1999 by sampling block**

| Block Number | Shrimp Catches | Fish By-catch | Ratio Shrimp: by-catch |
|---|---|---|---|
| BC74 | 4.9 | 3 | 1:0.6 |
| BF74 | 4.3 | 6 | 1:1.4 |
| BF75 | 8.3 | 5 | 1:0.6 |
| BG74 | 19.7 | 3 | 1:0.2 |
| BH72 | 1.9 | 40 | 1:21.1 |
| BH74 | 7.0 | 2 | 1:0.3 |
| BI73 | 2.1 | 2 | 1:1.0 |
| BI74 | 6.5 | 4 | 1:0.6 |
| BJ72 | 1.4 | 35 | 1:25.0 |
| BJ75 | 1.2 | - | - |
| BJ76 | 0.7 | - | - |
| BK73 | 3.2 | - | - |
| BK78 | 6.0 | 5 | 1:0.8 |

| Block Number | Shrimp Catches | Fish By-catch | Ratio Shrimp: by-catch |
|---|---|---|---|
| BM72 | 3.6 | 50 | 1:13.9 |
| BH82 | 7.5 | 5 | 1:0.7 |
| BI81 | 0.5 | - | - |
| BI82 | 6.0 | - | - |
| BI83 | 4.5 | 15 | 1:3.3 |
| BI85 | 3.5 | 10 | 1:2.9 |
| BJ82 | 7.0 | - | - |
| BJ83 | 14.1 | - | - |
| BJ71 | 3.5 | 40 | 11.4 |
| BM71 | 5.5 | 50 | 9.1 |

**Appendix 4. Results from GCC shrimp survey of shrimp catches (kg), fish by-catch weight (kg), and shrimp to fish by-catch ratio in April 1999 by sampling block**

| Block Number | Shrimp Catches | Fish By-catch | Ratio Shrimp:by-catch |
|---|---|---|---|
| BB72 | 14.0 | 20 | 1:1.4 |
| BC74 | 1.0 | 23 | 1:23 |
| BD75 | 4.0 | 18 | 1: 4.5 |
| BF75 | 3.0 | 18 | 1:6.0 |
| BI72 | 2.0 | 20 | 1:10.0 |
| BI74 | 2.5 | 2 | 1:0.8 |
| BJ72 | 2.0 | 12 | 1:6.0 |
| BJ73 | 4.0 | 4 | 1:1 |
| BJ74 | 2.0 | 2 | 1:1 |
| BJ75 | 3.0 | 2 | 1:0.7 |
| BJ76 | 3.0 | 22 | 1:7.3 |
| BK72 | 1.5 | 22 | 1:14.7 |
| BK76 | 2.0 | 125 | 1:62.5 |
| BK77 | 2.2 | 60 | 1:27.3 |

| Block Number | Shrimp Catches | Fish By-catch | Ratio Shrimp:by-catch |
|---|---|---|---|
| BL74 | .5 | 75 | 1:150.0 |
| BM73 | .5 | 75 | 1:150.0 |
| BH81 | 8 | 20 | 1:25 |
| BH83 | - | - | - |
| BI82 | .5 | 7 | 1:14.0 |
| BI83 | 2.0 | 15 | 1:7.5 |
| BI84 | .5 | 7 | 1:14.0 |
| BJ82 | 4.0 | 1 | 1:0.3 |
| BJ83 | 1.0 | 2 | 1:2.0 |
| BK82 | 4.0 | 2 | 1:0.5 |

**Appendix 5. Results from GCC shrimp survey of shrimp catches (kg), fish by-catch weight (kg), and shrimp to fish by-catch ratio in May 1999 by sampling block**

| Block Number | Shrimp Catches | Fish By-catch | Ratio Shrimp:by-catch |
|---|---|---|---|
| BB74 | 0.5 | - | - |
| BC72 | 1.2 | 20 | 1:16.7 |
| BD75 | 0.5 | 30 | 1:60.0 |
| BE75 | 3.7 | 20 | 1:5.4 |
| BF74 | 1 | 20 | 1:20.0 |
| BG74 | 0.4 | 25 | 1:62.5 |
| BH73 | 1.2 | 15 | 1:12.5 |
| BH74 | 1.0 | 2 | 1:2 |
| BI72 | 1.5 | 45 | 1:30 |
| BI74 | 3 | 4 | 1:1.3 |
| BI75 | 0.2 | 7 | 1:.35.0 |
| BJ72 | 1 | 15 | 1:15.0 |
| BJ74 | 0.3 | 15 | 1:50 |
| BJ76 | 1.5 | 30 | 1:20.0 |
| BK72 | 1.0 | 30 | 1:30.0 |

| Block Number | Shrimp Catches | Fish By-catch | Ratio Shrimp:by-catch |
|---|---|---|---|
| BK74 | 1.5 | 20 | 1:13.3 |
| BK75 | 1.7 | 45 | 1:46.5 |
| BK76 | 2.0 | 30 | 1:15.0 |
| BL72 | 1.0 | 45 | 1:45 |
| BH82 | 2 | 60 | 1:30 |
| BH83 | 0.4 | 15 | 1:37.5 |
| BI83 | 3 | 30 | 1:10 |
| BI84 | 1 | 15 | 1:15 |
| BJ82 | 17 | 45 | 1:2.6 |
| BJ84 | 1.3 | 10 | 1:7.7 |
| BK82 | 15 | 40 | 1:2.7 |
| BK83 | 1.9 | 10 | 1:5.3 |

**Appendix 6. Per species, average number of individuals per haul (X) and correspondent standard deviation (SD) in modified (with square mesh) and normal shrimp trawls**

| Fish Species | Modified Net | Normal Net | | [1]Significant | |
|---|---|---|---|---|---|
| | | X | SD | X | SD |
| *Pseudorhombus arsius* | 0.8 | 0.8 | 2.3 | 1.8 | NS |
| *Lutganus fulviflammus* | 1.0 | 1.2 | 2.5 | 1.1 | NS |
| *Lethrinus lentjan* | 6.5 | 6.3 | 4.3 | 1.6 | |
| *Lethrinus mahsenoides* | 0.8 | 0.4 | 2.8 | 1.6 | S |
| *Lethrinus nebulosus* | 0.5 | 0.9 | 1.3 | 1.3 | NS |
| *Acanthopagrus bifasciatus* | 0.3 | 0.4 | 1.0 | 0.7 | NS |
| ***Pomadasys stridens*** | **38.5** | **13.8** | **150.5** | **57.2** | **S** |
| *Siganus canaliculatus* | 4.8 | 3.1 | 8.3 | 4.0 | NS |
| *Gerres argyreus* | 42.3 | 20.4 | 41.0 | 24.7 | |
| *Gerres filamentosus* | 8.5 | 3.2 | 5.5 | 1.5 | |
| *Diplodus sargus kotschyi* | 0.5 | 0.5 | 0.5 | 0.5 | |
| *Rhabdosargus haffara* | 1006.5 | 410.1 | 940.5 | 584.6 | |

| Fish Species | Modified Net | Normal Net | | [1]Significant | |
|---|---|---|---|---|---|
| | | X | SD | X | SD |
| *Upeneus sulphureus* | 45.3 | 4. | 61.8 | 9.7 | S |
| *Upeneus tragula* | 0.8 | 0.8 | 1.0 | 0.7 | NS |
| *Sardinella gibbosa* | 0.5 | 0.5 | 0.5 | 0.9 | |
| *Alectis indicus* | 0.3 | 0.4 | 0.3 | 0.4 | |
| *Alepes djedaba* | 1.3 | 1.1 | 8.0 | 6.4 | |
| *Alepes melanoptera* | 0.3 | 0.4 | 1.5 | 0.9 | NS |
| *Sillago Sihama* | 0.3 | 0.4 | 0.0 | 0.0 | |
| *Solea bleekeri* | 0.5 | 0.9 | 0.5 | 0.9 | |
| *Selar crumenophthalmus* | 66.5 | 43.6 | 95.8 | 41.3 | S |
| *Sphyraena obtusata* | 10.0 | 3.9 | 34.0 | 22.6 | S |
| *Seriolina nigrofasciata* | 0.0 | 0.0 | 0.5 | 0.5 | |
| *Saurida tumbil* | 9.3 | 3.8 | 16.3 | 4.7 | S |
| *Arius thalassinus* | 10.8 | 4.5 | 11.0 | 9.7 | NS |
| ***Nematolosa nasus*** | **15.0** | **9.6** | **84.0** | **44.0** | **S** |
| *Batrachus grunniens* | 0.0 | 0.0 | 0.3 | 0.4 | |
| *Callionymus persicus* | 3.5 | 1.1 | 5.5 | 2.7 | NS |
| *Leiognathus bindus* | 8.0 | 1.9 | 12.5 | 4.8 | S |
| *Monacanthidae* | 456.5 | 124.5 | 422.5 | 42.6 | |
| *Nemipterus bleekeri* | 6.0 | 3.9 | 9.3 | 6.9 | NS |
| *Thynus orientalis* | 4.5 | 4.3 | 3.5 | 1.7 | |
| *Scolopsis taeniatus* | 4.3 | 3.3 | 3.5 | 2.6 | |
| *Platycephalus indicus* | 1.0 | 1.2 | 2.0 | 0.7 | NS |
| *Sorsogona tuberculata* | 1.5 | 2.6 | 3.3 | 4.1 | NS |
| *Plotosus lineatus* | 0.0 | 0.0 | 0.5 | 0.5 | |
| *Aesopia cornuta* | 1.0 | 0.3 | 0.0 | 0.0 | |
| *Pelates quadrilineatus* | 9.8 | 8.9 | 8.0 | 4.6 | |
| *Terapon puta* | 7.8 | 1.3 | 7.3 | 1.5 | |
| *Chelonodon patoca* | 0.3 | 0.4 | 0.3 | 0.4 | |

| Fish Species | Modified Net | Normal Net | | [1]Significant | |
|---|---|---|---|---|---|
| | | X | SD | X | SD |
| *Triacanthus biaculeatus* | 9.3 | 2.2 | 12.3 | 6.6 | NS |
| *Gastrophysus lunaris* | 93.3 | 57.8 | 173.8 | 62.0 | S |
| *Soleidae* | 0.3 | 0.5 | 0.0 | 0.0 | |
| *Carangoides bajad* | 0.3 | 0.5 | 0.0 | 0.0 | |
| *Scomberoides commersonianus* | 8.3 | 3.2 | 16.8 | 8.1 | S |
| *Rastrelliger kanagurta* | 3.3 | 2.5 | 17.8 | 12.1 | S |
| *Portunus pelagicus* | 101.5 | 26.5 | 153.3 | 15.6 | S |
| *Sepia spp.* | 20.0 | 10.4 | 18.5 | 7.2 | |
| ***Shrimp*[2]** | **843.8** | **159.0** | **1059.3** | **243.8** | **S** |
| *Chiloscyllium arabicus* | 7.5 | 2.5 | 13.5 | 7.7 | S |
| *Fistularia petimba* | 2.8 | 0.8 | 1.5 | 1.7 | |
| *Scomberomorus commerson* | 0.0 | 0.0 | 0.3 | 0.4 | |

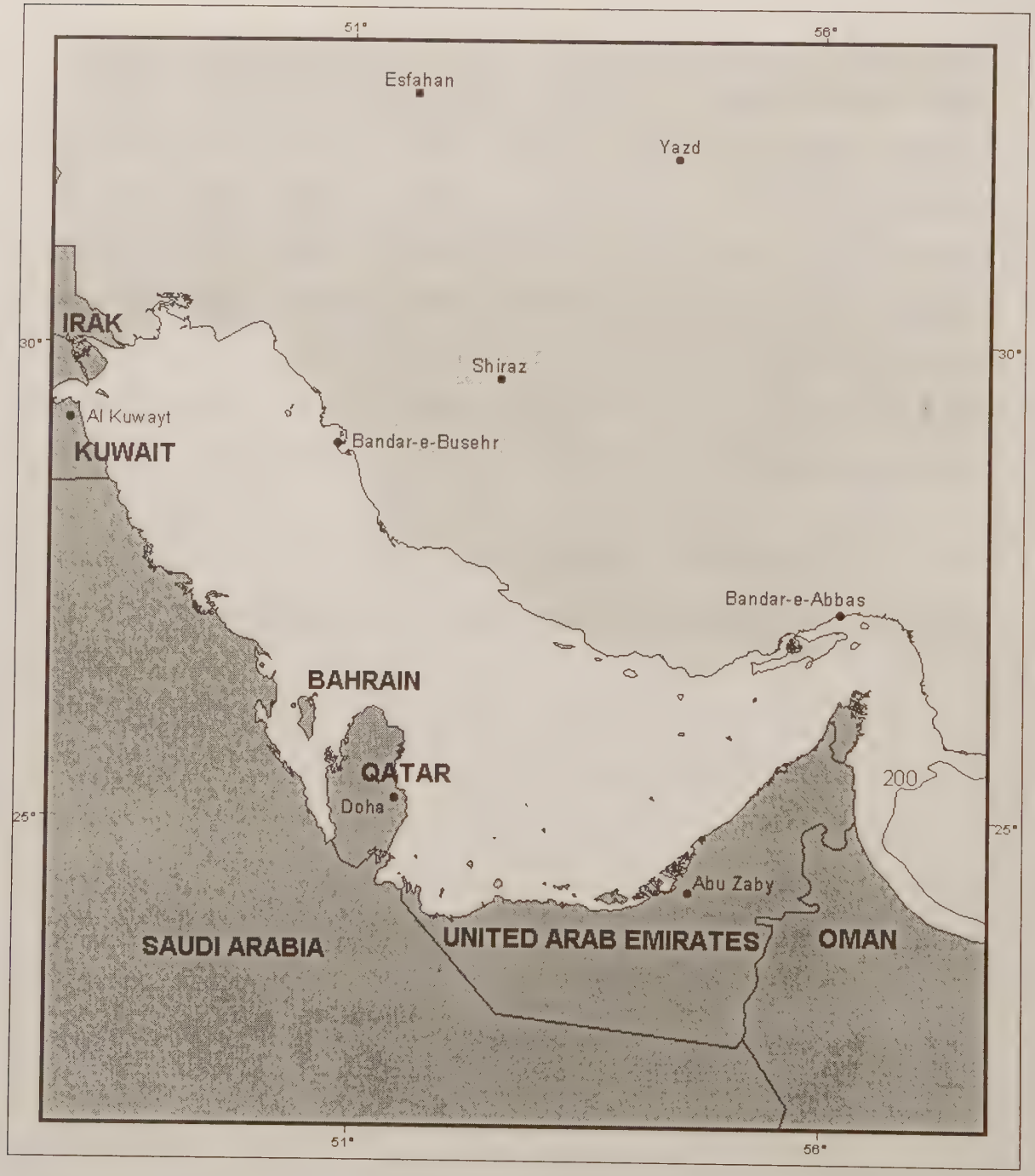
---

**1) Significant different at $\alpha = 0.05$ and n = 4, N= significant, NS= non significant.**
**2) Mainly *P. semisulcatus*.**

IRAN

## NATIONAL REPORT ON ENVIRONMENTAL IMPACT OF SHRIMP TRAWLING FISHERIES IN THE ISLAMIC REPUBLIC OF IRAN

by Ali Asghar Mojahedi, National Coordinator (Fisheries Co. of Iran; Ministry of Jehad; Naderi St. Keshavarz Blvd; PO Box: 14155 – 6353; Teheran; **Iran;** Fax: 98 21 6941673)



## Abstract

The estimate of the shrimp catch was 6 780 t for 1998. The main species differ according to fishing ground, e.g. tiger shrimp (*Penaeus semisulcatus*) is 80% of the catch in Bushehr Province while more than two thirds consisted of banana shrimp (*P.merguiensis*) in Hormozgan Province. It is worth mentioning the huge development of shrimp aquaculture since 1995. The amount of shrimp exported has increased over the last few years.

As an estimate, shrimp would be about 10-17% of the total catch when using shrimp trawls, juvenile fish being about half of the total catch.

The shrimp fishing fleet consists of 39 outrigger trawlers (decreasing over the last few years) and around 2 400 smaller traditional "Dhow" boats or FRP craft doing single trawling. The number of licences for trawling has been, over the last few years, seriously curtailed.

In each province the season for shrimp trawling lasts approximately six weeks: The opening is based on continuous survey of maturity and body length of shrimp, the closure is decided when trawl surveys indicate that only 20% of the shrimp stock remains. Fishing at night is prohibited in certain areas. In Hormozgan Province a control of the discards exists.

The main problems include: resources which are overfished; threat to fishing grounds and sea habitats due to expanded exploitation with very large by-catch; Lack of a defined and organised participation of fishermen, (interested parties) in rebuilding and protection of resources; lack in the fisheries management plans of consideration to biological and socio-economic factors; lack of regional collaboration in applying regulations.

A several-year programme is proposed for shrimp fisheries and their sustainable development with a precautionary approach. The programme includes: - improvement of the fishing technology with the introduction of by-catch reduction devices (BRDs) as a follow up to the tests carried out in 1997; - biological and environmental studies - better control of the fishing effort; - improvement of management plan; - adequate extension work and education to encourage the improvement of practices within industry; - improvement of fishing industry participation and relevant regional cooperation.



## Resumen

En 1998, se estima que las capturas de camarón alcanzaron las 6.780 toneladas. Las principales especies difieren dependiendo de la zona de pesca. Por ejemplo, el camarón tigre ("tiger shrimp" *Penaeus semisulcatus*) representó el 80% de las capturas de la Provincia de Bushehr. Mientras que el camarón banana ("banana shrimp" *P. merguiensis*) constituyó más de dos tercios de las capturas de la Provincia de Hormozgan. Vale la pena mencionar el enorme desarrollo del cultivo de camarón desde 1995. Asimismo, las exportaciones de este rubro han incrementado en los últimos años.

Se estima que las capturas de camarón representarán entre un 10 y un 17% de las capturas totales cuando se empleen arrastreros de camarón, mientras que las capturas de juveniles se ubicarán alrededor de la mitad de la captura total.

La flota camaronera está conformada por 39 arrastreros con tangones (decreciendo durante los últimos años) y alrededor de 2.400 pequeñas embarcaciones tradicionales "Dhow" o "FRP craft" que realizan arrastre con una red. En los últimos años el número de licencias para pesca de arrastre ha sido restringido seriamente.

En cada provincia la temporada de arrastre de camarón dura aproximadamente seis semanas: El inicio está basado en una evaluación continua de la madurez y longitud del camarón, el cierre de la temporada se decide cuando la evaluación del arrastre indica que sólo permanece el 20% del inventario camaronero en la zona. En ciertas áreas está prohibida la pesca nocturna. En la Provincia de Hormozgan existe un control de los descartes.

Los principales problemas incluyen: sobre pesca de los recursos; amenaza a zonas de pesca y hábitats marinos debido a la expansión de la explotación con elevada fauna de acompañamiento; falta de una participación definida y organizada de los pescadores, partes interesadas en reconstruir y proteger los recursos; falta de consideración de factores biológicos y socio económicos en los planes de manejo de pesquerías; falta de colaboración regional en la aplicación dè las regulaciones.

Está propuesto un programa de algunos años para la pesquería de camarón y su desarrollo sostenible, mediante un enfoque preventivo. El programa incluye: mejoramiento de la tecnología pesquera mediante la introducción de equipos de reducción de la fauna de acompañamiento (BRD) como seguimiento a las pruebas llevadas a cabo en 1997; estudios biológicos y ambientales; mejor control del esfuerzo pesquero; mejora en los planes de manejo; educación y trabajos de extensión adecuados que permitan fomentar mejora de prácticas dentro de la industria; mejoramiento de la participación de la industria pesquera y la cooperacion regional.

## 1. INTRODUCTION

Iran with an area of 1 648 195 km and a population of 60 million inhabitants, is located in the Near East Southwest of Asia. Iran has a coastline of 2 700 km in the north and south of the country (Caspian Sea, Persian Gulf and Oman Sea) and the area of inland waters is 1.5 million hectares. The south geographical specification of the Persian Gulf and the Sea of Oman are as follows: The Persian Gulf is situated between 30o and 24o longitude and 48o to 56o latitude. lran surrounds the Persian Gulf in the north, lraq and Kuwait to the west, Saudi Arabia to the southwest, along with Qatar, the United Arab Emirates and Bahrain to the southeast. It is also connected to the strait of Hormoz and Oman sea. The Persian Gulf has an area of 232 850 km$^2$ that stretches 930 km from the Arvandrood (Arvand River) up to the Oman Sea. Iran surrounds the Oman Sea in the north, the Indian Ocean in the east, and Oman in the southeast. It extends about 610 km from the coast to the west (including the Strait of Hormoz). The Oman Sea has an area of 903 km$^2$. There are 13 fishing zones with 6 fishing centres along the coasts of the four southern provinces.

## 2. FISHERIES PRODUCTION TREND

The fisheries production trend in the past decade is indicated in the flowing table:

**TABLE 1: Fisheries production trend**

| Year | 1979 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Production 1 000 t | 40 | 300 | 315 | 327 | 354 | 368 | 350 | 382 | 400 | 385 | 430 |

According to this, fisheries production during the mentioned years shows a ten fold growth.
(In 1998 the aquaculture share of the total production was about 8%)

## 3. SHRIMP FISHERIES

### 3.1 Catch Composition

Three major fish groups in the total catch of the south are as follows:

| | |
|---|---|
| Large pelagic species | 46% |
| Demersal species | 32% |
| Small pelagic species | 4% |
| Others | 18% |

### 3.2 Shrimp Catch

The Iranian shrimp fishery extends along much of the Iranian coast (with the exception of Sistan province in the southeast) and is divided into three regions or provinces, namely, Bushehr, Hormozgan and Khozestan.

The South's share in total catch is about 60% and 4-5% of this amount consists of shrimp.

The total shrimp catch reported in 1998 was 6 780 tonnes.

The catch volume in over recent years by province is indicated in the following table:

**TABLE 2: Shrimp catch by province**

| Province/year | 1996 | 1997 | 1998 |
|---|---|---|---|
| Khozestan | 876 | 990 | 1 330 |
| Bushehr | 3 460 | 1 870 | 2 650 |
| llonnozgan | 1 850 | 2 000 | 2 800 |
| TOTAL/tonnes | 5 885 | 4 860 | 6 780 |

### 3.3 Concerned Shrimp Species

The shrimp species found in the Iranian waters are as the following:

- *Penaeus merguiensis* (Banana shrimp)
- *Penaeus semisulcatus* (Tiger shrimp or Green tiger prawn)
- *Parapenaeopsis stylifera* (Kiddi shrimp)
- *Metapenaeus affinis* (Jinga shrimp)

The dominant target species in Honnozgan Province is banana shrimp (70%) and 30% for *Metapenaeus affinis*, Tiger shrimp and *Parapenaeopsis stylifera*. Tiger shrimp dominate in Bushehr Province (80%) and 20% of shrimp catch in this province is for *Metapenaeus affinis*. The dominant target species in Khozestan Province are *Metapenaeus affinis* and *Parapenaeopsis stylifera.*

### 3.4 Shrimp Export (amount and value)

The table below presents the amount and value of shrimp exported during past few years:

**TABLE 3: Shrimp exports**

| YEAR | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| Export/tonne | 849 | 1630 | 1000 | 1188 | 931 | 2100 | 2489 | 3095 |
| Value/000$ | 5574 | 7800 | 7000 | 9000 | 3588 | 8664 | 8986 | 9567 |

### 3.5 Shrimp Culture

Shrimp culture started in recent years. Between 1995 and 1998 it has produced 136, 163, 523 and 870 tonnes respectively. According to the long-term plan for shrimp culture expansions in 2020 a production of 150 000 tonnes of cultured shrimp can be expected.

### 3.6 Shrimp fishing methods

The shrimp are caught by bottom trawl.

The industrial shrimp trawlers (steel vessels) tow two trawls simultaneously with outriggers.This type of trawl has a four-seam design originating from the Mexico shrimp fishery. The wooden boats (Dhows) tow a single shrimp net and the FRP craft also use single trawl nets. The size and design of the nets is different according to vessel power and region.

### 3.7 Shrimp Trawling Fleet

As already mentioned three types of fleet are currently shrimp trawling and these can be divided into two sectors:

**A: Industrial sector (steel vessels)**

There are 39 steel trawlers between 20 to 30 m in length (mean length is 27m); the engine power for these vessels ranges from 250 to 600 kw (350 to 800 HP) and mean power is 750 HP.

**B: Artisanal sectors (wooden vessels and small GRP boats)**

Approximately 870 wooden vessels with 16 m average length (14 to 20 m), width 4.5 to 6.5 m and with 73 to 160 kw (100 to 220 HP) engine power, an average of 180 HP; the vessel capacity is between 45 and 65 tonnes.

Approximately 1 500 fibreglass (GRP) boats with 7 m mean length and 25 to 45 lip engines make up the third type of shrimp trawlers vessels.

Therefore nowadays more than 2 400 vessels (i.e. about 1/4 of the total number of fishing vessels) are engaged in the catch of shrimp during the fishing season. Shrimp fishing makes more than 15 000 direct employment opportunities as fishers and also many indirect jobs in marketing, processing, distribution, etc.

### 3.8 Shrimp Fishing Management

In Bushehr and Khozestan provinces the fishing is day and night operation whereas in Hormozgan province it is only a daily activity I.

In each province the season for shrimp trawling lasts approximately six weeks. For the opening of the fishing season, two elements, maturity and body length of shrimp, are studied through field survey. Different fishing grounds may be opened on different dates, if required.

Normally, in Bushehr province the fishing season begins early in mid-august and ends in late September. In Hormozgan, it begins mid-October and extends to late November and finally in Khozestan province it begins in mid/end October and extends to late December. The fishing season is closed on the basis of field studies to determine the percentage of the reserved stock and is closed when trawl surveys indicate that 20% of the shrimp stock remains.

The other management measures include a reduction of the number of new licences for shrimp trawling (this number has been, the last few years, seriously curtailed), introducing and applying some BRDs, control of fishing in the concerned fishing ground, control of discards (only in Hormozgan Province), etc. The number of vessels in the shrimp fishery has been less and less over the past few years, especially in industrial fleets, leaded by Iranian fisheries Companies, while the number of small GRP boats is increasing.

## 4. CATCH COMBINATION

In shrimp trawling the target species is shrimp, the rest of the catch in this study is referred to as by-catch. About 10-17% of the total catch consists of shrimp. The by-catch in this study is divided into three major categories:

(1) Small fish, under 15 cm in length, are 10-25% of the total catch.

They are all discarded. This group comprises:

| | |
|---|---|
| - Theraponidae, pony fish, threadfin bream | 40-60% |
| - shad, crab, mullet | 20-30% |
| - sardine, cat fish | 15-25% |
| - croaker,Triacanthidae | 5-10% |

(2) Juvenile fish: (40-60% of the total catch)

The juvenile fish discarded are usually under 30 cm in length and comprise:

| | |
|---|---|
| - flounder, indian flat head, cat fish, tongue sole | 40-60% |
| - shark, lizard fish, sting ray, sea bream | 30-40% |
| - silver pomfret, black pomfret, croaker, hair tail, snapper | 10-20% |

(3) Large Fish: (10-20% of total catch)

Large fish more than 30 cm in length comprise:

| | |
|---|---|
| - lizard lish, sting ray, flat head, shark, croaker | 75% |
| - hair tail, grouper, southern meager, grunt | 15% |
| - others | 10% |

## 5. MAJOR RESPONSIBILITIES OF THE FISHERY AUTHORITIES (DEPUTY FOR FISHING AND FISHERY INDUSTRIES)

- Elaboration of fishery policy, management of the fisheries, control of exploitation of aquatic resources
- Optimisation of exploitation methods;
- Planning and assistance for the manufacturing and provision of fishing gear and inputs;
- Management and maintenance of fishing ports;
- Support to the organization of fishermen cooperatives;
- Resource protection;
- Provision of training and extension programmes and services for fishing communities;
- Carrying out applied socio-economic studies;
- Support to development and marketting of added-value products.

## 6. MAJOR PROBLEMS IN ALL FISHERIES SECTORS

- Threat to fishing grounds and sea habitats due to expanded exploitation.
- Lack of a defined and organised participation of fishermen, (interested parties) in rebuilding and protection of resources.
- Lack in the fisheries management plans of consideration to biological and socio-economic factors.
- Lack of regional collaboration in applying regulations.

If these problems persist, the pressure on fishery resources will increase dangerously.

To improve the situation of resource exploitation, the following points are recommended:

- To improve the methods of exploitation and production in order, at the same time, to increase efficiency, decrease waste and protect the environment.
- To apply management plans on the basis of species or region.
- To set a maximum fishing effort compatible with sustainable yield.
- To consider the concerns and objectives of the interested parties in order to have proper participation in management, responsible exploitation, and preservation of the environment.
- To improve the manpower structure according to standards of job proficiency.
- To enhance executive and technical collaboration at regional level.

## 7. SHRIMP BY-CATCH REDUCTION IMPORTANCE

The Cancun Declaration (Mexico, 1992) provides that "States" should promote the development and use of selective fishing gear and practices that minimise waste of catch of target species and minimise by-catch of non-target species.

The Iranian shrimp fishery is typical of many tropical shrimp fisheries world wide being characterised by a wide variety of by-catch species. In the Persian Gulf as in other tropical areas many different species found in the same fishing ground, at the same time. The result is that due to the diversity of species in shrimp trawling grounds unwanted species is unavoidable.

**By-catch Reduction Devices**

The participants in the Working Group on shrimp and demersal fishes held in May 1996 (Kuwait) observed that the amount of by-catch resulting from intensive shrimp trawling in the Persian Gulf is becoming a very serious problem for the demersal fish stocks and for the sustainability of fisheries in the region. As overfishing is a problem in every Persian Gulf country with shrimp trawling industry having a serious impact on non-target species, i.e. by-catch, it is recommended that by-catch reduction devices (BRDs) be tested in the region and introduced with the commercial fishery.
Following are some BRDs that were tested so far:

**Squaremesh window**

This is one of the simplest BRDs. The window allows fish to escape upwards through large square mesh, while the shrimp that do not swim as well as fish are carried away with the currents into the cod-end.

**Parallel ropes**

Such a bycatch reduction device with parallel ropes consists in a window with parallel ropes extended lengthwise along the trawl (in place of square mesh). It is normally located in the same position as the square mesh window.

**Fisheye**

A fisheye is a small elliptical opening, steel framed which is arrangedin the codend to allow some fish to escape. It faces forward in the upper part of the codend. It is worth mentioning that fish passing into the codend must turn to swim forward to escape through this device.

**Cone**

The cone is not a BRD by itself but it is an element designed to increase the efficiency of BRDs to exclude fish from the trawl. It consists simply of two panels of netting attached to a small wire hoop and inserted behind a BRD such as: fisheye, square mesh window; the cone impedes the passage of fish into the codend and stimulates them to swim forward and through the escape openings.

**Rigid Grid**

The NAFTED was originally used by the Australian Maritime College to exclude large animals such as shark, stingrays and turtles (however some experience shows that in general small fish are also excluded). The NAFTED BRD features a grid, with a bar spacing appropriate to local conditions, secured to the trawl at 45 degrees. A panel of netting guides all animals to the bottom of the codend and prevents shrimp loss through the escape opening in the top of the codend. Large animals are physically guided through the escape opening while shrimp and other small animals pass through the bars and into the cod-end.

## 8. A SEVERAL-YEAR PROGRAMME CONCERNING SHRIMP FISHERIES

Over a on-and-half year period a programme aiming to the reduction of the bycatch, fish juveniles in particular, has been designed on the basis of field survey and experts and stakeholders consultation.

The overall objectives are:

- Improving the conservation and long-term sustainability of living aquatic resources
- Preventing irreversible or unacceptable damage to the environment
- Improving the social and economic benefits derived from fishing
- Improving the safety and working conditions of fishery workers

The practical purpose of the project includes:

- Reduction of by-catch in shrimp trawling
- Preventing fishing of unwanted fish
- Reduction in amount of discard fish
- At the end of the project it is expected that the shrimp trawling industry will use moreselective fishing gear, that there will be a drastic reduction of the amount of juvenile fish taken in the trawl nets and of waste, in general. It is also expected that management plans will be implemented for the various target fish populations and that there will be some reduction of the fishing effort on demersal fishes, in general.

For this purpose, the proposed activities include, among others:

- Testing several by-catch reduction devices under commercial fishing conditions, on board different type of vessels
- Ecological and biological studies concerning various species commonly caught by shrimp trawl
- Study of the relationship among the various groups of species and aquatic resources populations which are met in shrimp fishing grounds along the year.

It is observed that for such a programme concerning a shared resource among several countries of the Gulf, a regional collaboration is indispensable. A strong cooperation between the countries adjacent to the Persian Gulf is necessary to better regulate the shrimp fishery.

## 9. CONCLUSION

At this stage and concerning the impact of the shrimp fisheries and resources and environment, it is worth reminding a number of general agreed-on observation.

Recognizing that many aquatic resources are overfished and that the fishing capacity presently available jeopardizes their conservation and rational use, technological changes aimed solely at further increasing fishing capacity would not generally be seen as desirable.

Different capture technologies will have different effects on the ecosystem, the social structure of fishing communities, the safety of fishery workers and the ease, effectiveness and efficiency of management of the fishery.

A precautionary approach should be adopted for the development of new technologies or the transfer of existing technologies to other fisheries to avoid unplanned abrupt changes in fishing pressure or social pressures.

Each capture technology has advantages and disadvantages that should be balanced in a precautionary approach, and it may be better to have a mixed technology. When a new fishery technology is introduced, it should be carefully evaluated to assess its potential direct and indirect effects. If a mixed fishery technology representing "best current practice" in an area can be identified, precautionary management would encourage its adoption while it would discourage damaging ones. Responsible fishery technology achieves the specific fishery management objectives with minimum damaging side effects.

A precautionary approach would provide for a process of initial and ongoing review of the effects of the fishery technology introduced or evolving in local practice. However the extent to which a precautionary approach can be applied to the management of technological changes depends on the existing level of management. In some cases, education of fishermen and consumers towards responsible practices may be the only possible approach.

The benefits of technological improvements need adequate extension work and education to encourage their adoption.

## LOGICAL FRAME WORK

| Overall Objective | Objectively verifiable Indicators | Means of verification | Risks |
|---|---|---|---|
| • Optimising exploitation operations and methods<br>• Setting fishing effort compatible with sustainable yield<br>• Improving the conservation and long-term sustainability of the resources and fisheries<br>• Preventing irreversible or unacceptable damage to the environment<br>• Improving the long-term social and economical benefits from fishing | • By-catch reduction<br>• Increase in shrimp catch rate<br>• Reduction in discards<br>• Improved quality of shrimp<br>• Increase shrimp price<br>• Adjustment of fishing effort and reduction of it on the species overfished<br>• Increase of the demersal fish stocks<br>• Improvement of environmental indicators<br>• Reduction of conflicts and fishing competition<br>• More fishermen's participation<br>• Improved regional cooperation | Observers on board<br>Periodical study and evaluation<br>Systematic data collections<br>Measurements on the catch (shrimp and fish)<br>Biometry<br>Permanent control of fishing efforts<br>Fluctuation of shrimp market price<br>Organisation and participation of fishermen and fishery operators | • Insufficient attention to precautionary approach concepts in general<br>• Deficiency of fisheries management agreements<br>• No/or insufficient consideration to social aspects in fishery communities; including possible effect on fishermen's employment<br>• Lack of tests in real commercial and specific conditions, i.e. vessels with different sizes and arrangements, trawl nets in use, different fishing grounds<br>• Insufficient consideration to economic aspect, i.e. cost-benefit analysis and immediate economic impact.<br>• **Limitations in providing and setting BRDs**<br>• **Lack of regional cooperations**<br>• **Insufficient attention to fishermen's participation**<br>• Extension and training programme weakness |

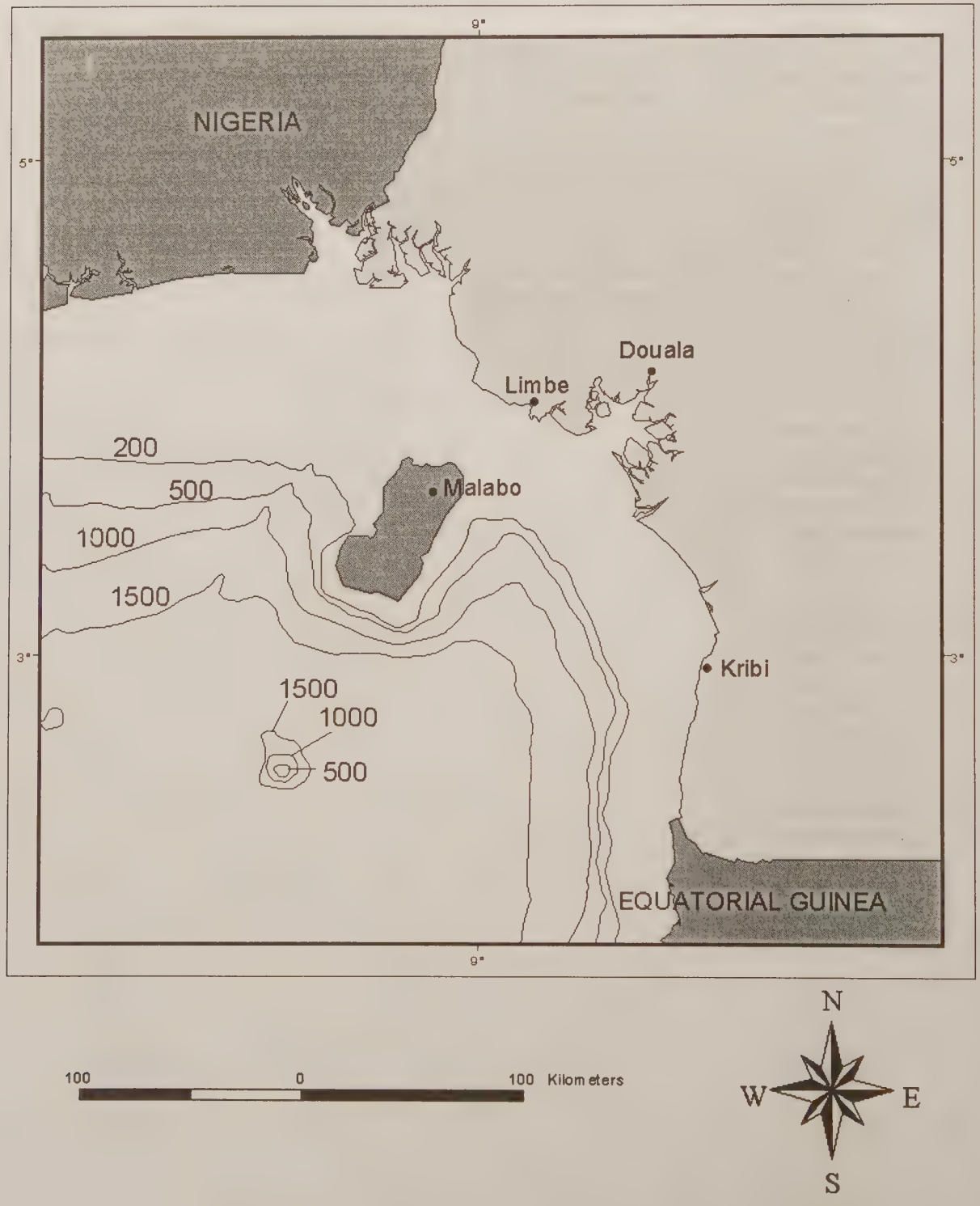
| Project immediate practical purpose | Expected results |
|---|---|
| • Reduction of by-catch in shrimp trawling<br>• To prevent fishing of unwanted fish<br>• To improve socio-economic benefits for fishermen<br>• To reduce the amount of discarded fish during the shrimp-trawling season<br>• To contribute to maintenance of species diversity and environmental quality | • Less of juvenile fish in the catch<br>• Less time spent for sorting the catch<br>• Improved quality of shrimp caught<br>• Higher value for shrimp caught<br>• Possibility of increasing shrimp catches<br>• Improved working condition of fishermen<br>• Adjustment of fishing effort to specific, target, demersal fishes and shrimp resources and proper fisheries management<br>• Reduction of fishing damage on environment<br>• Environmental quality properly maintained<br>• Possibly, increased trawling times<br>• Possibly, reducing crew number on board<br>• Improved technical capacities and skill of fishermen<br>• Maintenance/increase of income when trawling for shrimp<br>• Minimised waste and improved efficiency, in general<br>• Sustainability of fishery being ensured |

# AFRICA

## CAMEROON

### NATIONAL REPORT ON REDUCING THE IMPACT OF TROPICAL SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES THROUGH THE ADOPTION OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES IN CAMEROON

by J.C. Njock (Fishery Biologist, Director of Fisheries; Ministère de l'Elevage des Pêches et des Industries Animales; Direction des Pêches; Yaoundé, Cameroun) and O. Njifonjou (Socio-Economist, IRAD, Limbé, Cameroon)



Abstract

In 1996, the trawler landings consisted of 9 258 t of fish and 571 t of shrimp, (only, because companies do not declare the real quantities caught). These are *Penaeus notialis, Penaeus kerathurus* and *Parapenaeopsis atlantica.*

The by-catch constitutes normally around three quarters of the landed catch and around 75% of the finfish landed are juvenile. Only by-catch products are sold at the local markets. The quantity discarded at sea is unknown.

There were in 1998, 65 shrimp and 9 fish trawlers under the Cameroon flag, most of them operated within joint venture arrangements (so called 'time charter' companies).

The shrimp trawlers were initially fishing in waters of more than 30 m; later on they started to explore the coastal zone near estuaries, where nurseries are located and where the amount of fish caught greatly increased.

However, trawling within the zone of three nautical miles from the coast is, theoretically, prohibited (As well as the catch of juvenile fish). There is no legal fishing season.

The main problems reported include: over capacity and too high pressure on shallow water areas (where the nursery grounds are located), therefore, huge quantities of juvenile fish in landings; poaching by foreign boats is also mentioned.

Resumen

En 1996, los desembarcos de arrastreros reportaron 9.258 toneladas métricas de pescado y 571 toneladas métricas de camarón (se cree que estas cifras subestiman la verdadera producción dado que las compañías no declaran las capturas reales). Las principales especies son *Penaeus notialis*, *Penaeus kerathurus* y *Parapenaeopsis atlantica.*

Normalmente la fauna de acompañamiento constituye alrededor de tres cuartos de la captura descargada y los juveniles representan aproximadamente el 75% del pescado descargado. En los mercados locales se vende sólo fauna de acompañamiento. Se desconocen las cantidades descartadas en el mar.

En 1998, aparecen registrados con bandera de Camerún 65 arrastreros de camarón y 9 de pescado, la mayoría de estas embarcaciones operan mediante convenios de riesgo compartido ("joint venture"), también denominadas compañías "time charter".

Los arrastreros de camarón pescaban inicialmente en aguas de más de 30 metros; posteriormente comenzaron a explorar la zona de la costa cerca de los estuarios, donde se encuentran localizados los criaderos y donde la cantidad de pescado capturado incrementa enormemente.

Sin embargo, el arrastre dentro la zona de las tres millas náuticas de la costa se encuentra, teóricamente, prohibido (así como también la captura de juveniles). No existe una reglamentación oficial sobre la temporada de pesca.

Los principales problemas reportados incluyen: sobre capacidad y excesiva presión en zonas de aguas poco profundas donde se encuentran localizados los criaderos, razón por la cual se evidencian grandes cantidades de juveniles en los desembarcos; también se menciona la pesca furtiva por barcos extranjeros.

# 1. INTRODUCTION

## 1.1 General information

Cameroon lies between 9°30'E and 16° 00'E and extends from 2°N to 12°30'N. It has an area of 475 000 km$^2$ and a population of 14 million inhabitants. It is bordered on the west by Nigeria, on the north by Lake Chad, on the east by Chad and Central African Republic, on the south by Equatorial Guinea, Gabon and the Republic of Congo. Its coastline occupies the south-western part of the country at the extreme east of the Gulf of Guinea in the Bight of Biafra. The marine fisheries are divided into two major sectors:

The Cameroonian coastline stretches for about 360 km, extending from the border with Equatorial Guinea, south of Campo River estuary (2°20'N) to the Nigerian border north of Akwayafe River (4°40' N). The continental shelf area (up to 200 m depth) is about 13 000-14 000 km$^2$), while the total Exclusive Economic Zone (EEZ) area is around 25 000 km$^2$ (Njock, 1996). Several authors have made detailed reviews on the topography, oceanographic conditions and climate in Cameroonian's coastal and maritime area (Crosnier, 1964 ; Williams, 1969 ; Berrit, 1961, 1962a, 1962b, 1966 ; Njock, 1990 ; Djama, 1992 ; Njifonjou, 1998). The area is characterised by estuaries, mangrove forests, muddy and sandy bottom and heavy river discharges and rainfall.

The surface temperature is generally above 25°C and the salinity is always low, less than 35%. These two factors characterise the surface water of Cameroon and the entire Gulf of Guinea. The zone of warm and less saline waters is between 0 and 30 m. Below the warm layer lies the thermocline which extends between 30 and 50 m. The thermocline is marked by low temperatures varying from 26°C at the upper end of the thermocline to 18°C at the lower end. The salinity of the thermocline is higher (S ‰ >35 ‰). Like the whole eastern tropical zone of the Gulf of Guinea from Cotonou (Benin) to Cape Lopez (Gabon), the coast of Cameroon is not affected by seasonal upwelling.

The topographic conditions of the northern area of the continental shelf favour trawl fishing which exploits finfish in shallow water (< 25 m) and shrimp in deep water (>25 m). The narrow continental shelf makes that finfish and shrimp fisheries are not so well separated. There is overlapping of fishing grounds for the two types of activities. For the same reason, fishing grounds and nurseries are combined together.

## 1.2 Methods used in the study

Methods used in the study consist of the following activities :

- field visits to some fishing areas and fish markets ;
- outings on board commercial fishing vessels ;
- workshop attended by various stakeholders (fishermen, fish traders, NGOs , public Administrations);
- interviews with: (i) managers and skippers of fishing companies ; (ii) small scale fishermen ; and (iii) fish traders; and
- literature review.

**(1) Field Visits:** Some key fishing areas were visited to obtain information on artisanal fishing through interviews and the observation of fish-processing and fish-marketing practices. Fishing areas visited were :

- Wouri Estuary in Douala, Wouri Division
- Dockyard in Limbe, Fako Division
- Kribi Coastal Area, Ocean Division
- Mudeka Fishing Port, Tiko Sub-Division
- Sanje Village, Buea Sub-Division
- Ekondo Titi Beach, Ndian Division.

**(2) Interviews:** In all the areas visited, some important fishermen were interviewed to collect information on fishing methods used and the impact of regulation on their activities, the main species

exploited, the market and the income level. The interviews were conducted on the basis of guidelines and the method of "Knowledge, Aptitude and Participation (KAP)" proposed by FAO.

**(3) Workshop:** The objective of the workshop was to gather information on KAP of stakeholders regarding current shrimp fishing techniques and policies as well as new ones considered to be environmentally friendly.

**(4) Literature Review:** The existing National Legislation on fisheries was examined, the extent to which it is applied to the fishery activities and its impact on the conservation and sustainability of the fishery. Relevant literature on the subject was consulted.

**(5) Outing on board a commercial vessel**: The purpose was to evaluate the discards of fish, in terms of quantity and species composition.

## 2. THE SHRIMP FISHERY

### 2.1 Shrimp resources (species, areas of distribution, stock sizes)

Details regarding the coastal Penaeid shrimp recruitment features and a life-history pattern are given by Garcia and Le Reste (1981), Garcia (1977), and Garcia and Lhomme (1980). The first phase of the Penaeid shrimp's life takes place inshore in mangrove swamps, which are rich in nutrients. As their development progresses, the shrimps move to greater depths in the open sea. When the areas of distribution of juveniles and adults are clearly demarcated geographically, a seaward migration occurs after which spawning takes place. Three important Penaeid shrimps are met in Cameroon waters. *Penaeus notialis* (the pink shrimp) is the most dominant species. It lives in the lagoons, estuaries, creeks and open sea where it is targeted by shrimp trawlers, preferably at depths between 30 and 60 m. It stays on the muddy bottom at day time and migrates upwards at night. The pink shrimps may have maximum length size of 22 cm and a life span of 18 months. *Parapenaeopsis atlantica* (Guinea shrimp) is also fairly abundant in the open sea at depths between 10 and 30 m and occasionally occurs in estuaries and lagoons. Its maximum length is 16 cm. *Penaeus kerathurus* (the Caramote prawn) has maximum length of 23 cm. It lives in coastal waters. Like the pink shrimp, the Guinea shrimp and Caramote prawn are also targeted by shrimp trawlers. It is worth mentioning that during the last two years, shrimp trawlers have been harvesting very large specimens of shrimp never seen before (6 pieces/kg), measuring 25 to 30 cm; these might be the Caramote prawn (*Penaeus kerathurus)* or *Penaeus monodon*, but more investigations are needed for a better identification of this species. The Caramote prawn is also caught incidentally by artisanal fishermen, who exploit mainly the estuarine white shrimp *(Nematopalaemon hastatus)* of Palaemonidae family living in brackish water. The maximum yield potential for *Penaeus notialis* and *Parapenaeopsis atlantica* is around a 1 000 metric tonnes per year (Ssentongo and Njock, 1987).

### 2.2 Fishing methods (vessels and gear)

The marine fisheries of Cameroon are divided into two major sub-sectors: the industrial fisheries and the small scale/artisanal ones.

#### 2.2.1 Industrial Fisheries

##### 2.2.1.1 Vessels and gear

The industrial fishery uses otter trawlers, the characteristics of which have changed significantly during the last three decades as shown below in terms of average gross registered tonnage (GRT), engine horsepower (HP) and overall length of vessels.

**TABLE 1: Average characteristics of Cameroonian trawlers**

| *Characteristics* | *1969* | *1999* |
|---|---|---|
| Overall length (m) | 22 | 25 |
| Gross registered tonnage | 98 | 145 |
| Engine horsepower | 400 | 600 |

The fish trawlers use a single net, while the shrimp trawlers use two or four nets simultaneously, one or two on each side of the vessel towed at the extremities of two outriggers **(Florida type)**. The Florida type with twin trawls was introduced in Cameroon in 1998 by the CAMECRUS Company, which acquired 20 steel built boats from Spain. They are described in Box 1. Since 1999 the FINI Company introduced pair trawling into Cameroonian waters. Six of their boats use this technique for finfish.

**BOX 1: Description of vessels used by CAMECRUS**

**VESSEL**
Type of ownership: private company named CAMECRUS .
It is the leading company in the shrimp fishery with 25 boats.

**Description of the boats**
The boats were built in Spain in 1998. The autonomy during fishing activities is 30-35 days.
Registered Gross tonnage: 135
Overall length: 30 m
Average engine horsepower: 750 HP
Towing speed for fish 3nM; shrimp: 2nm
Fish finding equipment: Echo sounder FC 581 series 8831 01 64
Input: 10.5 30 ov
Frequency: 50 KHZ at shallow sea ; 200 KHZ at deep sea.

**Shrimp processing facilities on board**
8 freezing plates are available for 16 trays of 20 kg per tunnel;
Freezing temperature: –32° C;
Freezing duration: 3 hours;
Cooling room capacity: 60 metric tonnes.

**Operations**
The shrimp trawlers operate mainly along the Cameroonian coastal area.
However some are fishing in Mozambique, Gabon and Equatorial Guinea

**Duration of the fishing trip**
Nearest area: 3 hours
Far area: 6-8 hours

**General distribution of the bottom**
Muddy and sandy near the main rivers (Wouri, Sanaga, Nyong and Rio del Rey),
Rocky at Kribi, Campo and Limbé.

**Average trawling depth**: 25 m

**List of target species**
Shrimp
Croaker, Barracuda, Sole (high value species) and others

Source: CAMECRUS

Other companies use also outrigger trawlers but not with twin trawls but two main trawls only and a try net. The wings and the belly of the trawl are made of polypropylene and the cod-end of polyamide. The average mesh size of the codend for finfish trawl is 40 mm (stretched mesh) while that of shrimp trawl varies between 25 and 33 mm, according to the company, the size of the boat and the size of the net. None of the boats uses by-catch reduction devices (BRDs). Njock (1990) proposed the use of different models of trawls with different selectivity parameters/capacities to be used by shrimp and fish trawlers. But this recommendation has not been implemented so far.

There are several designs of shrimp trawls. The trawl used by the CAMECRUS Company is described in box 2.

**BOX 2: Description of gears used by CAMECRUS**

**DESIGN AND DETAILS OF TWIN TRAWLS**

**Gear**
Length of head rope: 18.20 m; diameter: combined wire: 16-18 mm;
Length of ground rope: 22.20 m; diameter: 18 mm;
Total length of the trawl: 22 m;
Bobbins, 2 types:
3 bobbins of 3 litres; and
6 bobbins of 1.5 litres

**Description of the ground rope**
The ground rope is made of combined wire and directly attached to the clean mesh of the net and tied with a thin rope to avoid abrasion. It does not have bobbins, but dickler chains are used to wake the fish and shrimp.

**Description of bridles**
Bridles are made of iron and 16 mm diameter, 75 to 80 m total length. Bridles have eye splicing at their edges and are attached to the main rope of the otters with shackles. There are three bridles, which are attached to the two otter doors and a sledge door in the middle.

**Description of the trawl wires**
Trawl wires are made of iron, total length per side 1 000 m, diameter 18 mm. There are no selective devices on the trawl. The vertical net opening is 6 m, and the horizontal net opening is 13 m/trawl.

**Description of the trawl winch**
Power: 60 kw (80 HP); Warp: 4,6 tonnes;
Total wire capacity: 2 000 m; diameter: 18 mm; warping end diameter: 235 mm;
Pull and speed at half drum (diameter: 480 mm);
Working pressure and oil flow required: 220 bars.

**Description of twin trawls**
The main rope is holding three bridles two of which are attached to the otter doors while one in the middle is connected to the sledge door. The otter doors are rectangular, made of wood with the following characteristics:
Weight: 270 kg/otter;
Length: 3.5 m;
Width: 1.10 m.

Source: CAMECRUS

In the past (1960s to 1980s), two state-owned companies were operating. One of them (CRECAM) was specialised in shrimp fishing. Actually, the fishing companies belong to the private sector. Shrimp are the target species. In fact, among the 18 companies registered, 16 of them own shrimp trawlers. The fishing industry is dominated by the so called 'Time Charter' companies which are a kind of joint venture involving nationals holding a 'Fishing Authorisation', and foreigners with boats. The Cameroonian counterpart receives royalties from his partner who owns the catch. This catch is fraudulently exported and sold abroad. Only by-catch products comprising mainly juvenile fish are sold in local markets. Nine 'Time Charter' companies were registered in 1998. In addition, three local companies (COPEMAR, SOCIAA, and CAMECRUS) sell their products locally, except for shrimp, which is exported.

### 2.2.1.2 Fishing companies

The demersal fish and shrimp resources have been exploited by industrial fleets since 1951 (Laure, 1969, 1972 ; Njock, 1979). TABLE 2 shows boats belonging to several fishing companies.

**TABLE 2: Fish (FT) and shrimp (ST) trawling fishing companies**

| | 1987 | | 1990 | | 1994 | | 1998 | |
|---|---|---|---|---|---|---|---|---|
| Fishing Companies | FT | ST | FT | ST | FT | ST | FT | ST |
| CHALUCAM | 6 | | 6 | | 3 | | | |
| COTONNEC | 4 | 1 | 6 | | | | | |
| COPEMAR | 11 | | 13 | | 9 | | 9 | |
| CRECAM | 6 | | 5 | | | | | |
| SOCIA | | | | | 4 | | 4 | |
| CAMECRUS | 6 | | 8 | | 4 | | 20 | |
| NEPTUNE | | | | | 10 | | 10 | |
| KOSCAM | | | | | 2 | | | |
| OFMC | | | | | 3 | | 3 | |
| SODEMAR | | | | | 1 | | | |
| SOGESCAM | | | | | 2 | | 2 | |
| STL | | | | | 1 | | 1 | |
| AMBI-BACK | | | | | 3 | | | |
| RIM | | | | | 3 | | 3 | |
| ABOLO | | | | | | | 4 | |
| SOPIC | | | | | | | 2 | |
| PEIX | | | | | 10 | | 8 | |
| FINI | | | | | | | 8 | |
| | | | | | | | | |
| TOTAL | 10 | 24 | 12 | 26 | 13 | 42 | 9 | 65 |

Source: MINEPIA

### 2.2.2 Small Scale Shrimp Fisheries

Artisanal shrimp fishing is practised, as mentioned before, in estuaries and creek zones. This is mostly located in artisanal fishing camps of Mabeta and Mboko in Fako Division, as well as Mokala and Bamusso in Ndian Division. Only one type of net is used for this purpose. This net is locally known as "ngoto". The ngoto is used to exploit small estuary shrimp, *Nematopalaemon hastatus*. It has a conical shape and is 7 to 9 m long with a circular or rectangular opening depending on the type used. The ngoto has a very small mesh size (mosquito net) and the species caught has a mean length of about 6 cm. The ngoto is normally attached to a monoxyle or plank canoe of 7 to 11 m long and about 1.7 m wide with as propulsion mean, paddle or sail but in most cases, 8 or 15 horsepower engine. Nearly 200 fishing canoes are active in the fishing camps of Mabeta, and 75% of them are motorised.

## 2.3 Effort data

Table 3 shows the trends of the industrial fleet between 1970 and 1998. The fleet comprises fish trawlers and shrimp trawlers. In the 1970s, fish trawlers outnumbered shrimp trawlers. But from 1970 to 1998, the number of fish trawlers fell by two thirds. At the same time there has been a high increase in the number of shrimp trawlers: from 10 in 1970 to 65 in 1998. It would have been better to express the fishing effort in terms of number of fishing hours or number of fishing days at sea, but it is not possible for the present situation where most of the companies practice "Time Charter". Nevertheless, the fishing effort in terms of number of days at sea is available from CAMECRUS Company which lands all its products in the country. Between 1993 and 1998, the average fishing effort per fishing boat varies from 157 to 200 days per annum. This could indicate the increase in the fishing effort during that

period, but the real situation is very confusing because of the practice of Time Charter as mentioned before and poaching activities carried out by foreign vessels.

### 2.4 Fishing practices

At the beginning of the shrimp fishing industry in the early 1970s, boats explored deep waters (depth > 30 m). Later on they started exploring the coastal zone and estuaries where nurseries are located. The combined effect of the pressure of fishing effort and the use of non selective fishing techniques has caused biological overexploitation of the main demersal finfish species, including *Pseudotolithus elongatus, Pseudotolithus senegalensis* and *Pseudotolithus typus.* As shown in TABLE 4, the length at first capture is smaller than the length at first sexual maturity for those fish species. This situation constitutes the main constraint to resource conservation and sustainable development of the fisheries sector. For Sciaenid species, Njock (1990) showed that this situation can be overcome by simultaneously reducing the fishing effort and increasing the mesh size. The author also proposed the use of selective fishing nets. Due to the lack of means of control and surveillance, poaching by foreign boats also constitutes a threat to the marine resources.

The traditional fishing grounds for finfish trawlers are supposed to be at least 3 nautical miles off the estuaries in the coastal sector between Rio del Rey-Bibundi Bay and River Nyong estuary and possibly outside the 20 m depth exploited by the small scale fisheries. Unfortunately, studies (Njock, 1979) indicate that finfish trawlers concentrate their fishing effort in the coastal sector between 6 m and 25 m. This sad situation, existing since the early 1980s, has now become more serious. The consequence of the intensive exploitation of coastal areas, is a serious threat to demersal resources that are mostly caught at the juvenile stage. Thus, there is a need to enforce fishing regulations in this coastal zone (0-25 m depth) in order to avoid conflicts between the industrial and the small scale fisheries. A realistic solution to this problem is the establishment of an effective system of monitoring, control and surveillance.

**TABLE 3: Trends of the fleet in trawling fisheries (1970-1998)**

| Year | Fish Trawlers | Shrimp trawlers | Total |
|---|---|---|---|
| 1970 | 25 | 10 | 35 |
| 1971 | 28 | 13 | 41 |
| 1972 | 29 | 13 | 42 |
| 1973 | 29 | 13 | 42 |
| 1974 | 23 | 16 | 39 |
| 1975 | 19 | 18 | 37 |
| 1976 | 19 | 18 | 37 |
| 1977 | 17 | 17 | 34 |
| 1978 | 17 | 16 | 33 |
| 1979 | 19 | 18 | 37 |
| 1980 | 23 | 22 | 45 |
| 1981 | 28 | 16 | 44 |
| 1982 | 22 | 15 | 37 |
| 1983 | 15 | 16 | 31 |
| 1984 | 12 | 19 | 31 |
| 1985 | 12 | 17 | 29 |
| 1986 | 9 | 19 | 28 |
| 1987 | 8 | 26 | 34 |
| 1988 | 12 | 25 | 37 |
| 1989 | 8 | 28 | 36 |
| 1990 | 12 | 26 | 38 |
| 1991 | 9 | 34 | 43 |
| 1992 | 6 | 33 | 39 |
| 1993 | 10 | 41 | 51 |
| 1994 | 13 | 42 | 55 |
| 1995 | 9 | 36 | 45 |
| 1996 | 9 | 45 | 54 |
| 1997 | 9 | 46 | 55 |
| 1998 | 9 | 65 | 74 |

Source: MINEPIA/DIRPEC

The shrimp trawlers which exploit the pink shrimp *(Penaeus notialis)* operate mainly in the coastal zone between the Cameroon and Rio del Rey rivers. Sometimes, they operate off the Sanaga river. The pink shrimp are dominant at a depth of 30 to 60 m. The Guinea shrimp *(Parapenaeopsis atlantica)* and the Caramote prawn *(Penaeus kerathurus)* are found in the shallower coastal sector of 10 to 30 m depth. The main fishing grounds for those species are located between Sanaga river and the Ambas Bay. TABLE 4 shows that shrimp trawlers using smaller mesh in their codend have even a more negative effect on finfish than fish trawlers. Because of this, it can be concluded that overexploitation of fish resources is mostly due to shrimp trawling.

**TABLE 4: Mean selection length size used by fish trawlers (40 mm), and shrimp trawlers (33 mm), and length at first sexual maturity of three demersal fish species**

| Species | Selection length (mesh size 40mm) | Selection length (mesh size 33 mm) | Length at fist sexual maturity (L50) |
|---|---|---|---|
| *P. elongatus* | 12 cm | 9.9 cm | 19.5 cm |
| *P. senegalensis* | 14 cm | 11.55cm | 26.5 cm |
| *P. typus* | 15.2 cm | 12.54 cm | 26.5 cm |

Source: Njock, 1990

## 2.5 Trends of landings

Table 5 and Figure 1 show the trends of landings. In the 1970s and 1980s the total landings levelled up to a plateau of 20 000 MT/year while shrimps production reached 2 400 MT/year. At present, the total landings are less than 10 000 MT a year, of which shrimp account for around 500 MT/year. The actual low level of the landings cannot be explained only by overexploitation. It is also due to the 'Time Charter' companies which do not declare the real quantities caught.

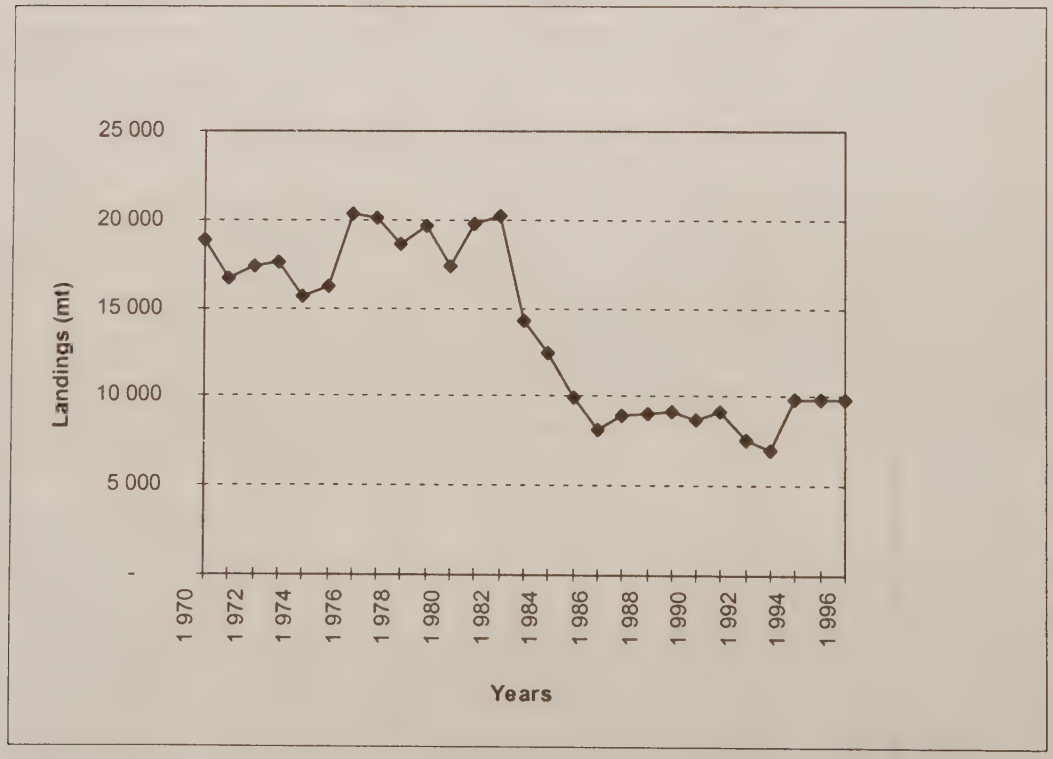



**Figure 1: Trends of landings (MT) from 1970 to 1996**

**TABLE 5: Landings of trawling fisheries industry (1970-1996)**

| Year | Shrimp | Fish | Total |
|---|---|---|---|
| 1970 | 942 | 17846 | 18788 |
| 1971 | 1759 | 14883 | 16642 |
| 1972 | 2360 | 15016 | 17376 |
| 1973 | 2358 | 15189 | 17547 |
| 1974 | 1960 | 13730 | 15690 |
| 1975 | 1696 | 14556 | 16252 |
| 1976 | 1796 | 18550 | 20346 |
| 1977 | 2438 | 17684 | 20122 |
| 1978 | 980 | 17654 | 18634 |
| 1979 | 548 | 19091 | 19639 |
| 1980 | 268 | 17056 | 17324 |
| 1981 | 338 | 19445 | 19783 |
| 1982 | 565 | 19657 | 20222 |
| 1983 | 581 | 13649 | 14230 |
| 1984 | 858 | 11599 | 12457 |
| 1985 | 661 | 9295 | 9956 |
| 1986 | 658 | 7454 | 8112 |
| 1987 | 879 | 8080 | 8959 |
| 1988 | 1042 | 7923 | 8965 |
| 1989 | 1179 | 7939 | 9118 |
| 1990 | 1092 | 7636 | 8728 |
| 1991 | 933 | 8243 | 9176 |
| 1992 | 461 | 7083 | 7544 |
| 1993 | 460 | 6482 | 6942 |
| 1994 | 520 | 9278 | 9798 |
| 1995 | 571 | 9852 | 9829 |
| 1996 | 571 | 9258 | 9829 |

Source: MINEPIA/DIRPEC

The list of important commercial species exploited by the industrial fishing is shown in TABLE 6. It should be noted that the catch is normally grouped into commercial categories instead, not into species.

**TABLE 6: List of commercially important species exploited by the industrial fleets, with some commercial size categories**

| Cameroonian Commercial name | FAO English name | Species | Commercial size Category (cm) |
|---|---|---|---|
| Bar | Longneck croaker | *Pseudotolithus typus* | 30-60 cm |
| Bar | Longneck croaker | *Pseudotolithus senegalensis* | 30-60 cm |
| Bossu | Bobo croaker | *Pseudotolithus elongatus* | |
| Gros brochet | Guinean barracuda | *Sphyraena piscatorium* | >60 |
| Gros capitaine | Giant African threadfin | *Polydactylus quadrifilis* | >60 |
| Petit capitaine | Small African threadfin | *Galeoides decadactylus* | |
| Carpe | Snapper | *Lutjanus spp* | |
| Congre | Conger | *Conger, Paraconger Arisoma* | |
| Disque | African moony | *Psettias sebae (Psetus sebae)* | |
| Dorade grise | Scompat grunt | *Pomadasys jubelini* | |
| Dorade rose | Red seabream | *Dentex spp., Pagellus* | |
| Friture | Bobo croaker | *Pseudotolithus elongatus* | < 21 |
| Friture | Ladyfish | *Pseudotolithustypus* | < 21 |
| Friture | Royal threadfin | *Pentanemus quinquarius* | < 21 |
| Friture | Silver drum | *Pteroscion peli* | < 21 |
| Gros | Threadfin | *Polydactylus quadrifilis* | > 60 |

| Cameroonian Commercial name | FAO English name | Species | Commercial size Category (cm) |
|---|---|---|---|
| Gros | Cassava croaker | *Pseudotolithus senegalensis* | > 60 |
| Gros | Snapper | *Lutjanus spp.* | |
| Mâchoiron | Sea catfish | *Arius spp.* | |
| Mérou | Grouper | *Epinephelus spp.* | |
| Ombrine | Croaker | *Pseudolithus spp.* | |
| Raie | Stringray | *Dasyatis spp. (Rajidae)* | |
| Rouget | West African goatfish | *Pseudopenaeus prayensis* | |
| Disque | African sicklefish | *Drepane africana* | |
| Sole | Tonguesoles | *Cynoglossus spp.* | |
| Crevette | Pink shrimp | *Penaeus notialis* | |
| Crevette | Caramote shrimp | *Penaeus kerathurus* | |
| Crevette | Guinean shrimp | *Parapenaeopsis atlantica* | |
| Crabe | Smooth swimcrab | *Portunus validus* | |
| Langouste | Royal spiny lobster | *Panulirus regius* | |
| Seiche | Cuttlefish | *Sepia spp.* | |
| Calmar | Squid | *Loliginidae* | |

Source: Ssentongo and Njock, 1987; Njock, 1990 (< = Less than ; > = More than).

## 2.6 By-catches and discards

### 2.6.1 General situation and definition

For the last fifteen years, the target species in trawl fishing have been Penaeid shrimps.

After the devaluation of the CFA franc in 1994, the demand for low commercial value fish increased in the country and smaller fish were commercialised. This induced the landing of by-catch of low value, including juvenile fish, leading at the same time to excessive exploitation of fish resources.

In the Cameroonian context, by-catch will be defined as species taken in a fishery targeting other species or different size range of the same species. The discard here will be all the by-catch returned to the sea, usually dead or dying (Commonwealth of Australia, 1991).
In Cameroon, by-catches constitute 95% of the products landed. This includes finfish and a few crabs. Seventy-five percent of the finfish landed are juvenile. All the by-catch landed is used for human consumption.

The quantity which is discarded at sea is unknown. Boats are not using any by-catch reduction devices.

### 2.6.2 Analysis of the discard samples

A brief research and observation mission was carried out on board a shrimp fishing trawler in 1999 to study the discards: identifing the different species which are discarded and analysing the length frequency distribution of the various species. Out of samples amounting to a total of 67 kg of discards, two categories of fish were identified:

- the low commercial value by-catch totally discarded (hairtail, shad, crabs), and
- the juveniles of marketable fish.

#### 2.6.2.1 Composition of the samples

The composition of the samples was as follows

- Marin debris 21%
- Hairtails (*Trichurus lepturus)* 16%
- Crabs 13%
- Shad (*Ilisha africana*) 8%
- Other juvenile fish 42%

### 2.6.2.2 Specific composition

The analysis of specific composition of the samples shows that nearly 40 different species are caught and discarded (Table 7).

### 2.6.2.3 Size and weight frequencies of species found in discards

The size and weight of each species found in the discards were measured. The results of these are presented in Annex 1. Table shows minimum and maximum weights and lengths by species. The weight of individual species ranged from 1.6 g to 127.8 g. While the size of discarded fish ranged from 4.5 cm to 23 cm, according to species.

**TABLE 7: Various species identified in the discards of shrimps fishing trawlers.**

| N° | Common name | Family name | Scientific name |
|---|---|---|---|
| 1. | Soles | Soleidae | *Synaptura sp* |
| 2. | | Cynoglossidae | *cynoglossus senegalensis* |
| 3. | Bonga (sardine) | Clupeidae | *Sardinella maderensis* |
| 4 | | | *Ethmalosa fimbriata* |
| 5. | Bars | Scianidae | *Pseudotolithus senegalensis* |
| 6. | | | *P. typus* |
| 7. | | | *P. elongatus* |
| 8. | Petits capitaines | Pomadasyidae | *Pomadasys rogeri* |
| 9. | | | *Galoides decadactylus* |
| 10. | | | *Polydactylus sp* |
| 11. | (Fritures) | | *Brachydeuterus auritus* |
| 12. | Grands capitaines | Polynemidae | *Pentanemus quinquarius* |
| 13. | Disque | | *Drepana africana* |
| 14. | Fritures | | *Eucinostamus melanopterus* |
| 15. | | Tetradontidae | *Lagocephalus laevigatus* |
| 16. | | Bagridae | *Chrysichtis negrodigitatus* |
| 17. | Carangues | Carangidae | *Selen dorsalis* |
| 18. | | | *Alectis alexandrinus* |
| 19. | | | *Caranx hippos* |
| 20. | | | *Caranx senegalus* |
| 21. | | | *Chlorocombrus chrysurus* |
| 22. | | | *Trachurus sp* |
| 23. | Ceintures | Trichiuridae | *Trichiurus lepturus* |
| 24. | Raies | Rajidae | *Raja miraletus* |
| 25. | | Dasyatidae | *Dasyatis margarita* |
| 26. | Barracuda | Sphyraenidae | *Sphyraena piscatorium* |
| 27. | | Sparidae | *Pagellus spp* |
| 28. | | | *Dentex spp* |
| 29. | Rasoirs | Clupeidae | *Ilisha africana* |
| 30. | Crabs | Calapidae | *Calappa rubroguttata* |
| 31. | | Squillidae | *Squilla aculeata calmani* |
| 32. | | Portunidae | |
| 33. | Mulets | Mugilidae | *Mugil spp* |
| 34. | | | *Mugil capunil* |
| 35. | Seiche | Sepiolidae | *Sepia spp* |
| 36. | Shrimps | Peneidae | *Penaeus notialis* |
| 37. | | | *P. keraturus* |
| 38. | Carpes | Lutjanidae | *Lutjanus spp* |
| 39. | Congres | | *Conger* |
| 40. | Machoiron | Ariidae | *Arius heudeloti* |
| 42 | Ceintures | Trichiuridae | *Trichurus lepturus* |
| 43 | Sharks | | |

**TABLE 8: Minimum and maximum weight (g) and length (cm) of fish discards**

| | *Brachy-deterus auritus* | *P. Typus* | *P.senega-lensis* | *Cynoglossus* spp. | *Drepana africana* | *Pentanemus quinquarius* | *Polydactylus quadrifilis* | *Chloros-combrus chrysurus* | *Turbot* | *Selene dorsalis* |
|---|---|---|---|---|---|---|---|---|---|---|
| **Smallest fish** | 5,5g | 4g | 10,3g | 7,2g | 8,3g | 8,9g | 7,9g | 21,1g | 8,3g | 1,6g |
| | 8 cm | 8 cm | 11 cm | 9,5 cm | 7,5 cm | 12 cm | 9,5 cm | 12 cm | 10 cm | 4,5 cm |
| **Biggest fish** | 37,1g | 42,2g | 25,5g | 104,2g | 54,6g | 39,9g | 38,5g | 34,9g | 35,9g | 127,8g |
| | 16 cm | 20 cm | 15 cm | 23,5 cm | 13 cm | 18 cm | 16,5 cm | 15,5 cm | 16 cm | 23 cm |

### 2.7 Distribution of catches (inland and export market)

During the above mentioned fishing trip it was observed that the landings are processed, packaged and frozen on board: fish being ready for sale in the local marketand shrimps, ready for export;

Two species of shrimps are targeted, in priority: the Caramote prawn (*Penaeus kerathurus*) and the pink shrimp (*Penaeus notialis*). Both species are sold in grades varying from zero to seven according to sizes. The Caramote prawn corresponds to the grade with the lowest value (it is the one that is sold in the local market and in neighbouring countries) and constitutes 70% of the total shrimp catch. Almost 96% of the shrimp caught are exported and the main markets are the EU, the USA and Japan.

Actually the main fishing company (CAMECRUS) uses to group fish caught into 10 commercial categories. These include average size bars, small size bars, average size soles, small size soles, others, big fish species, fritures, MIX 3, rays and sharks. All the fish landed is sold fresh in the local market.

By-catch including fish of low commercial value and juveniles of marketable fish which are normally discarded are collected from the fishing boats by the artisanal fishmongers and traders to be sold locally.

### 2.8 Socio-economic role

The fisheries sector plays an important role in Cameroon with regard to its contribution to animal protein food self-sufficiency (46% of animal proteins consumed in the country), employment and income. From the various surveys (Njock, 1985; Njifonjou *et al.*, 1995), approximately 250 000 persons live or depend on the artisanal and commercial sectors.

#### 2.8.1 The industrial sector

##### 2.8.1.1 Social background

Very few studies have been done on the socio-economic aspects concerning the industrial sector. From the information gathered from the different fishing companies during the present field studies, the number of persons working in the sector can be estimated to 1 300 (administrative staff, crews and other).

The average size of the crew members is around 15. On board a vessel with standard characteristics, it was observed that the average age of the crew members was 28 years (which, as a matter of fact, might illustrate the young state of fishing Company, CAMECRUS). The sector is also characterised by the weakness of the regulation concerning the crew profession.

### 2.8.1.2 Income

With regards of the very weak regulation concerning workers in the sector, the salaries are low. Three-quarter of the crew members interviewed on board an industrial fishing vessel declared earning around 50 000 FCFA per month, only. Even the captain does not earn much. It is worth observing that such salaries are lower than those of the purse seine crew members in the artisanal sector. Such very low salaries greatly explain why crew members use to ysell fraudulently fish at sea.

As already mentioned, all fish captured is sold locally, while shrimp is mostly exported. During the 1970s and early 1980s, it was estimated that an average of 1 000 tonnes of shrimp was exported yearly. Nowadays, as stated in the document, this production has dropped to around 500 tonnes. This provides total revenue of approximately US$ 10 000 000 FCFA to the country economy.

### 2.8.2 Features of artisanal fisheries

Detailed information on the structure of the artisanal fishery is presented in several documents: Njock (1985), Ssentongo and Njock (1987), Kébé *et al.* (1993) and Njifonjou *et al.* (1995).

Artisanal fishing units operate mostly within a distance of 3 nm from the shoreline. The canoes concentrate within the estuaries, creeks and coastal inshore sector of surface warm waters above the thermocline.

Figure 3 shows the main estuaries and coastal fishing settlements as well as the five administrative statistical regions (Ndian, Fako, Wouri, Sanaga and Ocean) based on two surveys in 1985 (by Njock) and 1995 (by Njifonjou *et al.*). The general features for the artisanal fishery sector are given in Table 9.

The huge majority of the fishermen in the artisanal sector are immigrant. They come mainly from Nigeria, Ghana and Benin. This predominance in the sector could be a major constraint to the development and rational management of the artisanal fishery sector.

Between 1983 and 1995, a general increase in fishing effort was observed. However, after 1990, there was a reduction in motorization due to the high prices of fishing material resulting from structural adjustments and an increase of various taxes.

The artisanal fishery mainly exploits pelagic fish using small meshed monofilament gillnets to catch Bonga and *Sardinella* and to a lesser extent, some demersal resources (croakers and threadfins) with bottom gillnets. The exploiation of shrimp is limited to catching white shrimp *(Nematopalaemon hastatus)* with 'ngoto' nets.

**TABLE 9: Features of Cameroonian artisanal fishery**

| RESULTS | 1983 survey | 1995 survey |
|---|---|---|
| Number of main fishing villages | 57 | 206 |
| Number of canoes | 6,011 | 7,335 |
| Range of canoe length | 4 - 17 m | 4 - 20 m |
| Non – motorized canoes | 67% | 73% |
| Motorised canoes | 33% | 27% |
| Total number of fishermen | 18,625 | 24,136 |
| Percentage of indigenous fishermen | 10 % | 17 % |
| Percentage of immigrant fishermen | 90 % | 83 % |

Sources: Njock (1985) ; Njifonjou *et al.* (1995).

### 2.8.2.1 Fishing vessels, gear and operations for catching shrimp

As already mentioned, within the artisanal fishery sector, the shrimp, mainly white shrimps *(Nematopalaemon hastatus)* are exploited with special conical or rectangular shrimp nets locally called 'ngoto' nets with a mesh size of 10 mm. These nets are normally used by large-sized planked canoes, 10-12 m long, Nigeria type, each one carrying an average of 15-35 'ngoto' nets (Each crew members has 5 'ngoto' and the owner of the canoe 15, meaning a total of 35 "ngoto" per engine-powered canoe; the number of 'ngoto' is 15 only when the fishing crew uses paddles).. They are common around estuaries of the northern coastal sector of Cameroon (Mabeta and Bekumu fishing villages):

A fishing licence is required, against an annual payment of 3 000 CFAF and a registration fee of 4 200 CFAF. The fishing season goes from July to December.

Official statistics show annual catches of 220 to 260 tonnes in 1993 and 1996 respectively, with a total value of 200 million CFAF; in the Mabeta-Mudeka area alone, 90 tonnes of shrimp would have been caugtht in 1997.

The small estuary shrimp locally known as Njanga or Manjanga, is sold dry in the local market and in neighbouring countries. This product is used as an ingredient in many local dishes.

The other following types of gear also catch some shrimps in very shallow waters and along the coast:

(a) the beach seine (also known as 'drawing net' or 'drawing chain') catches pelagic and demersal fish and also some small shrimp in mostly coastal inshore sandy areas;

(b) the cast net (locally known as 'mbunja')

### 2.8.2.2 Target species exploited by the artisanal fishery

The Cameroonian artisanal fishery uses a combination of gear to catch a mixture of pelagic and demersal fish. *Ethmalosa fimbriata* (bonga or bepa, épa belolo, etc.), *Sardinella maderensis* (short sardine or bélolo, strong kanda, ndololo, etc.), *Ilisha africana* (shad or munyanya), *Caranx/Chloroscombrus* (jacks /Atlantic bumper of mutungu, motondo), catfish (*Arius sp.)*, several croakers (*Pseudotolithus elongatus, senegalensis, typus),*threadfin and flatfish such as *Cynoglossus spp*. (Guinean and Nigerian tonguesoles). As already mentioned the shrimps consist mainly in *Nematopalaemon* (estuary white shrimp or njanga).

It is worth mentioning that sampling the artisanal catch is made difficult by the different common names used for fish along the coast of Cameroon and also by some species having specific names for different growth phases. For example, *Ethmalosa fimbriata* is known as bonga, epa, bepa, paga, belolo, ndololo and mulolo whereas juvenile bonga and *Sardinella* and other species (croakers) are known as nyamtolo ; nyamtolo fishing is very destructive ; it uses harmful practices with small meshed nets to catch juvenile fish species around Cape Cameroon in Wouri Division.

Pelagic species *Ethmalosa fimbriata* and *Sardinella maderensis*, the small estuarine shrimp *Nematopalaemon hastatus* are usually processed (smoke-dried) as well as the juvenile fish from shrimp trawler by-catch. Thus, most of the catch is, in general, processed by women and either sold on the local market or exported to Nigeria. Demersal fish from artisanal fisheries and marketable by-catch are generally sold fresh.

### 2.8.3 Socio-economic case study of the artisanal sector

For this study, a hundred and twenty nine persons from various socio-professional categories within the fisheries sector were surveyed. The breakdown of the sample by professional groupings is as follows: Artisanal fishermen of both shrimp and finfish fisheries 20%, operators in shrimp trawl fisheries 20%, fishmongers including by-catch collectors and sellers 20%, fish and shrimp processors (smoke-dryers) 20%, other agents including boat builders 20%.

Among these fishing operators, 17% are Cameroonians, while the rest (nearly 83 %) are foreigners, mostly Nigerians (77%).

### 2.8.3.1 Social background

There exits approximately 24 000 fishermen and about 7 000 women involved in the processing and marketing of fish products. The sector also generate a lot of opportunities for informal employment, informal and institutional "rent capturing" activities.

Average age of the sample varies from 33 to 55 years. Among the various socio-professional categories, canoe builders and fishermen are relatively young and many of them are single. Boat owners are older.

Average family size varies from 7 for fishmongers and traders to 9 for fishermen. About 83% of the operators work full time; 62% males and 48% females can read and write. Literacy rate is relatively highest among fishermen and boat builders. However, this does not show the real educational status in the field. Apart from the fishing villages situated around big towns, many of the fishing camps mostly located in creeks and mangroves (this includes all those involved in the shrimp fisheries), have no direct access by roads, no schools, no health centres, no infrastructures providing facilities for drinking water and electricity. Among the different group samples, membership of monotheist religion is very high (85%). This seems to reduce occultism and the offering of gifts to the gods of the sea. The housing situation is very poor particularly in the creeks and mangroves where these people live in huts.

The primary wish of most fishermen is to become proprietors of fishing units. Younger fishermen expressed the wish to change jobs. The main attractions are fish and retail trades, particularly by-catch ones, as well as other more remunerative jobs. The profession is passed on from father to son (76% of respondents) or through marriage to an operator in the sector. Of the processors (smokers of fish and shrimp) 87% are fishermen's wives.

However, 85% of the target population of all categories would like to see their sons go to school and later become doctors, engineers, teachers, bankers or any other more lucrative, cleaner and less tiring professions than fishing. According to them, fishing is a job for illiterates, a domain in which they operate simply for lack of better jobs.

In the sector there is no professional association acting for the different operators. However, a number of mutual aid family associations, for example rotating saving associations exit and informal credit arrangements is the rule within these communities. There is also no financial institution such as a Savings and Loans Cooperative, Bank credit lines, etc., financing production, processing or commercialisation of the fisheries products.

Fish and shrimp trading and processing is essentially carried out by women. In addition to their work equipment (smoking huts) some women own fishing units. The women often finance fishing trips or even an entire fishing campaign in return for the purchase of catches. Generally richer than their husbands, these women are fully responsible for the expenses of their households. Genuine heads of enterprises, they play a very important role within the community.

### 2.8.3.2 Incomes

Recent socio-economic studies on costs and earnings in the artisanal fisheries (Njifonjou, 1987 ; 1998) show the income amount earned by the different operators of the sector. On average, the owners of the Purse Seine units (PS ) fishery (recently introduced to Cameroon from Ghana in the 1970s) realise a yearly surplus of about 9 million CFAF, Surface Gillnet (SGN) units 278 000 CFAF and Bottom Gillnet Net (BGN) 165 000 CFAF, the profitability rates being 50%, 10% and 15%, respectively. The fishermen's annual incomes are about 622 000 CFAF for those operating the purse seine, 408 000 CFAF for those using surface gillnets and 338 000 CFAF with bottom gillnets.

The processor's incomes range from 640 000 to 850 000 CFAF for those processing shrimp working only 4 months a year, while for those processing finfish on the entire year, the incomes vary between 500 000 and 700 000 CFAF. The fishmongers (fish and shrimp) income varies widely, ranging from 850 000 CFAF to 1 450 000 CFAF per year. A survey conducted for this Programme among the "Basket Women" (name of the fishmonger association dealing mostly with by-catch from trawl fisheries), reveals an annual income of about 1 050 000 CFAF when products are available around the year.

Thus, these data show that the monthly revenue in the sector ranges from 28 000 CFAF (for small-scale fishermen fishing with bottom gillnets) to 121 000 CFAF (fishmongers and shrimp traders).

The important outcome from the economic analysis of the sector (Njifonjou *et al.*, 1998), is the financial attractiveness of the small scale fishery sector, in general, particularly the purse seine fishery, shrimp fishing and the fishmonger activity. Compared to government officers, to farmers or to other activities within rural coastal communities, boat owners and fishmongers as well as fishermen, have similar or higher income.

### 2.8.4 Conflicts and competition between sub-sectors

There exist conflicts, competition and physical interactions among the sub-sectors. Artisanal and industrial shrimp fisheries interact on each other when operating on the same fishing zones. The areas concerned are mainly estuaries (Rio-del-Rey, Wouri, Sanaga and Nyong rivers) and the very closed coastal zones, which are legally prohibited from trawl fisheries.

As stated by Djama (1992), physical interactions encompass gear destruction caused by the encroachment of shrimp trawlers on canoe fishing grounds. This conflict is a result mainly of competition for the same resources and the same fishing grounds. This situation causes damage to artisanal fishing gear. More than ten cases are reported every month. Some of artisanal fishermen believe that trawlers use their nets as an indicator of fish abundance and therefore run over them to increase their catch. More likely, fishermen of both sectors have the experience to know where fish can be found abundantly at a given period of the day or of the year, and normally the area is the same for both sectors so that, where there is a set gillnet you always notice the presence of trawlers. This may also reflect the fact that the continental shelf is narrow (15 nautical miles) and also that fishing grounds and nursery zones are almost the sames. It is worth observing that, normally, trawlers do avoid destroying many set gillnets while this may happen by accident. However, it cannot be excluded that sometimes some destruction might have happened deliberately.

It is difficult to resolve this kind of conflict. Most of the times none of the artisanal fishermen are present when the damage to their fishing gear occurs. Even the identification of the trawler by the artisanal fisherman does not help matters as the legislation in force recognises only the report from a sworn officer either from the Merchant Marine, Navy or from the Ministry in charge of fisheries. Even through these services, there is no provision in the actual legislation for compensation to be given to the artisanal fishermen. Such conflicts centre mainly on the problem of property or territory rights.

The effects of encroachment have been detrimental to the artisanal fishermen, not only with regard to the destruction or loss of their fishing gear, but mainly because shrimp trawlers also catch on coastal fishing grounds a large quantity of small fish.

As already mentioned, large quantities of fish are caught along with shrimp (the ratio fish to shrimp being 20:1 and 25:1 depending on season).and are often discarded at sea, either because they are smaller than market sizes or because of the limited storage facilities on board. As it has been observed during a recent trip at sea, the discard is mainly composed of the smaller-size fish particularly juveniles (total length less than 20 cm) and of a few species of low economic value. This practice is really harmful to other fisheries which aim to catch the same fish at bigger sizes. However, it is worth observing that very little research has been carried out so far on by-catch and discards related problems.

The fishes which are discarded have little chance to survive according to studies on the survival rate of several tropical species (Seidel, 1975). The discarding is a wastage, in general, from which it results loss for other fisheries.

To summarize, it is therefore observed that shrimp trawling has, in general, a very negative impact on the environment, the resources as well as on the other fisheries and the impact on endangered species still remains unknown to a large extent (because of a lack of relevant consistent data).

## 3. REGULATIONS AND MANAGEMENT MEASURES (INCLUDING THE USE OF SELECTIVE DEVICES, CLOSED AREAS AND CLOSED SEASONS)

### 3.1 Regulations

The law in force regarding the fishery sector is Law No. 94/01, dated 20 January 1994, on Forestry, Wildlife, and Fisheries.. Its Decree of application No. 95/413/PM, dated 20 June 1995, defines conditions of access to marine living resources. Its Chapter IV deals with the protection of fisheries resources in five specific zones close to the coast within the three nautical miles sector from the shore. Trawling activities are prohibited inside these sectors. Other texts of application are expected for the limitation of the mesh sizes and the regulation of the fleet capacity.

The existing fishery regulations is to a large extent not fully implemented (the prohibition of trawling within the three nautical miles zone is the best exemple), for various reasons including:

- the recent Fisheries Law (Law No. 94/01 of 20 January 1994) and its text of application have not been fully explained to the fishing communities. This is due to the lack of means to enable fishery officers access to fishing settlements;
- because of control problems, sanctioning has been very difficult and in some cases impossible. Sanctioning of offenders would indeed be a good way to increase the awareness of stakeholders;
- there are no specific programmes made up by the Ministry in charge of fisheries to explain, educate and motivate the fishing population regarding the fishery regulations ;
- the Environmental Law which regulates activities in respect to pollution of coastal waters and erosion is not implemented because the texts of application are not ready ;
- the national artisanal fishing population is only 17% while the rest are aliens. It is obviously more difficult to make that the aliens apply the regulations of the nation where they operate;
- lack of an efficient system of monitoring, control and surveillance.

### 3.2 Policy and management

The main objectives of the fisheries policy are: to realise self-sufficiency in fish production and therefore to reduce imports; to improve livelihood of fishery communities and to ensure the sustainability of the fisheries, including with necessary renewal of the industrial fishing fleet. These objectives favour encouraging fish production and free access to the resources.

To achieve the above mentioned objectives, the Government has to:

- train fishermen and finance the construction of necessary infrastructures;
- make fishing material available;
- facilitate progress in the handling, processing , storage, and marketing of the products of fisheries and
- for the production of fish through aquaculture, the equipment of "fish farming stations" for making fingerlings available to fish farmers.

To support the sector, the Government established five institutions: the Fund for the Development of Maritime Artisanal Fishery (CDPM), the National Authority for the Development of Small Scale Fishery (MIDEPECAM), the Foumban Fishery Training Centre, the Limbé Fishery and Oceanographic Resarch Station, and the Douala Institute for Fishery Sciences within the University of Douala (This last institution, is not yet operational).

The Cameroonian fisheries policy is well documented (Corsi *et al.,* 1991 ; Kébé *et al.*, 1993). Njock (1997) observed that the fishery authorities in charge of the development and management of the sector favour, in generaL, multisectoral integration and community involvement. It is worth mentioning that this is a sign of evolution compared to the previous situation when the policy formulation was issued, top down, from selected fisheries managers. Three strategy lines have been drawn: (i) strengthening of institutional arrangements, including organisations, training, improvement of regulations; (ii) management of fisheries according to responsible fisheries principles, safety at sea, and environment protection ; (iii) funding of the fishery sector.

Among these issues, the most urgent seems to be the development of responsible fisheries. This practically means: increase in mesh size, reduction of over-capacity, and precautionary approach for the conservation, management and exploitation of living aquatic resources in order ensure the sustainability of the industry and to preserve the aquatic environment (see FAO, 1995).

No mention is made so far of any management measures including the use of selective devices, protected areas, and closed seasons.

According to the existing fishery regulation the following actions are prohibited:

- trawling within the zone of three nautical miles from the coast (this area is considered to be legally reserved for the artisanal fishery);
- the use of poison, dynamite and pesticides;
- the catch of juvenile fish;
- fishing with boats of more than 250 GRT.

In addition to this, it is specified in the regulation that the permit for the importation of exotic species may be granted under certain conditions only.

Fish and shrimp trawler companies must have an 'Industrial Fishing Authorization' and a 'Fishing Licence' for each active boat. A technical inspection of the fishing vessel is required before a licence is issued.

However, due to the lack of effective control, these management measures are not effectively respected. Moreover, it is observed that the existing measures do not fully take into account the views of the stakeholders, in particular, small-scale fishing communities. In respect to this, a reason for this situation is that the local communities have no forum for dialogue with other actors of the sector.

Practically, the marine fisheries resources management policy is weak. This can be explained by the lack of careful appraisal of the situation, especially regarding availability of living resources and socio-economic conditions locally. Another reason is the difficulty to take decisions including limitation of access to natural resources even when scientific evidences are available forthe decision-making process.

## 4. RESEARCH ACTIVITIES

Fisheries research is carried out by the Limbé Fisheries and Oceanographic Research Station (SRHOL). As far as the shrimp resources and fisheries are concerned, no proper research has been carried out so far (regarding for instance stock assessment and the actual level of exploitation).

Table 10 shows the list of the actual research operations in the Fisheries and Aquaculture Program of the research station in Limbe. It is worth observing that the Program includes among others the study of the socio-economic conditions for fisheries management, but, as already mentioned, nothing concerning shrimp fishery.

## 5. IMPACT OF PRESENT EXPLOITATION PATTERN ON SHRIMP RESOURCES

As already noted, the shrimp fisheries have not been studied as such so far in the country. The only reference is indeed the history of the fishery: There was a constant increase in the number of trawlers up to the 1970s when it was realized that resources were overexploited. For this reason, a few shrimp trawlers were then transformed into finfish trawlers. A few years later, in 1983, the stock was found having recovered and, as a result, many shrimp trawlers came back progressively into activity. These trawlers used to operate in areas of above 30 m depth, targeting shrimp of big sizes. With the decline in big size shrimps, these trawlers started targeting smaller species close to the coast. This trend continued until 1997. Even though more boats are registered as Cameroonian vessels, they sell most of their production abroad directly without declaring any catch to the relevant fishery statistics services. This situation has led to an apparent reduction in the official production of shrimp and cannot obviously allow an efficient management of the sector.

**TABLE 10: Research operations in the Fisheries and Aquaculture Programme in 1999**

| Operation title | Themes | Operations |
|---|---|---|
| Estimation of size at first maturity of main species | Fisheries biology | 03/04/01/01/01 |
| Assessment of the resource exploited | Stock assessment | 03/04/01/02/01 |
| Protection of endangered aquatic species | Biodiversity Inv. | 03/04/01/02/02 |
| Studies on appropriate fishing methods | Fishing technology | 03/04/01/03/01 |
| Assessment of the nurseries zones | Marine ecology | 03/04/01/04/01 |
| Economic impacts of the artisanal fisheries | Fisheries management | 03/04/01/05/01 |
| Evaluation and standardisation of the fishing effort | Stock assessment | 03/04/01/05/02 |
| Evaluation of the artisanal fisheries catch | Stock assessment | 03/04/01/05/03 |
| Appropriate techniques in polyculture | Aquaculture techniques | 03/04/01/01/02 |
| Evaluation of the fingerling growth | Valorisation | 03/04/01/03/02 |

## 6. IMPACT OF PRESENT SHRIMP EXPLOITATION PATTERN ON FISH RESOURCES

As can be seen on Table 11, the exploitation rate, the ratio of the mortality by fishing to the total one, is for eight common demersal fish species exploited by trawl fishing more than 0.5; it practically means that such species are already threatened with over-exploitation (Njock; 1990).

**TABLE 11: Exploitation rates of the main demersal species exploited in Cameroonian waters**

| SPECIES | Exploitation rates : Fishing Mortality/Total Mortality |
|---|---|
| *Pseudotolithus elongatus* | 0.733 |
| *Pseudotolithus senegalensis* | 0.591 |
| *Pseudotolithus typus* | 0.657 |
| *Cynoglossus canariensis* | 0.594 |
| *Galeoides decadactylus* | 0.622 |
| *Pentanemus quinquarius* | 0.739 |
| *Arius heudeloti* | 0.589 |
| *Arius parkii* | 0.592 |

## 7. IMPACT OF PRESENT FISHING PRACTICES ON NON-FISH BY-CATCH

There has been no specific study concerning the impact of non-fish by-catch. Nevertheless, it was observed recently on board an industrial outrigger shrimp trawler that the discarding consisted in: crabs (13%), marine debris (21%), in addition to 42% including juvenile fish, jellyfish, gastropods, mantis shrimp, etc.

## 8. IMPACT OF PRESENT FISHING PRACTICES ON THE BOTTOM HABITAT

As concerning non-fish by-catch, no special study has been carried out so far in the field. During the above-mentioned fishing trip, some observations were made on the way the bottom habitat is affected by the trawl fishing. In fact, the otter door, the ground rope and the dickler chains dig into the muddy or sandy bottom in order to dislodge shrimp and flat fish which are then trapped in the trawls. By so doing, big quantities of bottom material (sand, mud, etc.), where many invertebrates (polychets, crustaceans, gastropods, bivalves) live are extracted from the bottom, causing serious harm to the ecosystem.

## 9. PERCEPTION OF THE PRESENT SITUATION REGARDING SHRIMP EXPLOITATION INCLUDING ENVIRONMENTAL IMPACT

The environmental impact of the present situation regarding shrimp exploitation by the different operators, was discussed and highlighted between all concerned both on board shrimp trawlers (see Annexe 1) and during a workshop with the participation of the stakeholders (see Annexe 2).

### 9.1 The shrimp fishing industry

The shrimp fishing industry recognises that trawling for shrimp has an impact on the environment, especially on the juveniles and on the low commercial value by-catch that are discarded at sea. The impact is even made worse because geographical conditions make that, in Cameroon, both the artisanal and industrial fleets are practically sharing the same fishing grounds and the same resources. The observations and comments of the operators of the industrial sub-sector include the following:

- Continued reduction of the average size of shrimp caught;
- Decrease in total shrimp production;
- Lack of knowledge on the size of the resources now exploited;
- Long administrative procedures to export shrimp;
- High taxation on production;
- Poaching in Cameroonian waters by foreign vessels;
- Unavailability of fishing materials and electronic equipment;
- No valorisation of the by-catch as done in other countries.

For the management procedures of the shrimp resources the group recommend the following:

- Monitoring the issue of Fishing Authorisations;
- Determination of the fishing zone limits being assigned to fleets according to the size of vessels;
- Prohibition of the twins trawling;

- Reduction of the fishing effort by reducing the number of vessels authorised to fish shrimp;
- Establishing a closed season for the biological rest: 2 to 3 months per year.

### 9.2 Artisanal/small-scale fishermen

For the members of this group, the way the industrial shrimp trawlers operate in Cameroon greatly affects their situation as well as to the environment. Shrimp trawling is perceived only as a destructive activity: - When "sharing" or competing for the same resources, the trawlers are said catching the juveniles, therefore causing loss to the other fisheries (artisanal) which catch the same fish at bigger sizes. - When fishing onthe same fishing zones, the trawlers are said to destroy nets set by small-scale fishermen, causing a great loss for the sector. The statements made to express the situation include:

- No respect of the regulations by the industrial sector, particularly the three nautical miles prohibited for trawling fishing;
- Destruction of the nurseries;
- Massive exploitation of the juveniles by trawlers;
- Conflicts between Artisanal and Industrial fisheries in terms of the destruction of the artisanal fishing gear by trawlers;
- Unorganised market for the by-catch of the shrimp trawler which make that there is competition with the artisanal product for supplying fish to the poor communities;
- No respect of the fishing zone limits by the industrial fisheries.

### 9.3 Environmental organisations

During the workshop, the NGOs complained about the following:

- Lack of awareness of fishermen on the fisheries laws and regulations;
- Destruction of mangrove for fuel wood consumption;
- Destruction of the nurseries;

- Massive exploitation of the juveniles finfish by trawlers;
- Use of non-selective gears;
- Absence of adequate Monitoring, Control and Surveillance of the fishing fleets.

### 9.4 Fishery Authorities, Officers dealing with environment, researchers

The perception by the administration and the research sectors is expressed as follow:

- Ignorance of the biology of shrimp species
- Lack of knowledge on fish stock
- Inadequate fishing agreements with countries which have abundant fisheries resources
- Insufficient funding and inadequate equipment for the Fisheries Department
- Inadequate enforcement of fisheries law and monitoring of fisheries activities
- Insufficiently qualified staff for the Fisheries Department
- Lack of collaboration between various actors of the fisheries sector
- Ignorance of the proper mesh size for shrimp fisheries
- Inadequate scientific research on shrimp species
- Lack of data on physico-chemical parameters
- Fishing operation carried out in too shallow waters
- Lack of sub-regional organisation to facilitate the exchange of fisheries information
- Lack of a master plan for the management of fisheries resources
- Massive catch of juvenile fish

## 10. KNOWLEDGE ABOUT NEW ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES BY THE SHRIMP FISHING INDUSTRY

Some skippers know of the "Turtle Excluder Device" but have never experienced it with their company. They also talk about the biological rest, nurseries zones delimitation and marine protected areas that are applied elsewhere. But they had never heard of By-catch Reduction Devices (BRDs) before the workshop in September 1999.

## 11. PERCEPTION BY THE SHRIMP FISHING INDUSTRY TO MODIFY THEIR FISHING PRACTICES TOWARDS MORE ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES

The operators of the shrimp fishing industry sector concede that they should modify their fishing way of doing towards more environmentally friendly techniques and practices. However, they point out the foreseeable additional expenses for such operations. The possible changes that industry people are considering include the adoption of the legal mesh size, avoiding fishing in nursery zones and the creation of marine protected areas. The reinforcement of control and monitoring of the fishing activities, in order to avoid piracy by foreign vessels, should accompany their effort.

They agree, in principle, on the importance of adopting fishing practices having already proven their effectiveness for allowing sustainable fishing activities because of the preservation of the biodiversity and continuous reconstitution of fish and shrimp stocks.

## 12. THE SOCIAL IMPLICATIONS OF ADJUSTING FISHING TO MORE ENVIRONMENTALLY FRIENDLY PRACTICES

Systematic surveys, trips on board trawlers and discussion during meetings all show that adjusting fishing to more environmentally friendly practices will have anyway serious social implications. These include:

- Providing credit facilities for additional equipment; identification and establishment of alternative activities when necessary;
- Reduction of revenues of fish traders due to the decrease in landed by-catch;
- Higher costs of fishing gear with the addition of a By-catch Reduction Device;
- Lower opportunity cost due to the reduction of by-catch;
- Renegotiations of the contracts with various partners (banks, administration, etc.);

- Setting up a compensatory system (incentives) for the crew members;
- Providing funds for feasibility studies, sensitisation, testing and training on the use of By-catch Reduction Devices, the establishment of protected areas, etc;
- Recurrent loss in the catch;
- On short term, lost of profit for professionals;
- Establishment of professional organisations to facilitate the application of the BRDs and adoption of any other technique or practice;

## 13. PRIORITY ISSUES REQUIRING ACTIONS TO MEET ACCEPTABLE STANDARDS OF ENVIRONMENTALLY FRIENDLY SHRIMP EXPLOITATION IN CAMEROON

To meet acceptable standards of environmentally friendly techniques in the sector, the participants in the workshop held in September 1999 (Annex 2) identified some priority issues and recommend unanimously the following :

- Implication of all the stakeholders including decision-makers, research institutions and professionals in the process of adoption of more environmentally friendly techniques;
- Assessment of the shrimp stock (quantity and potential value);
- Enforcement of control and monitoring of fishing operations at sea;
- Reduction of the rate of issue of fishing licences;
- Monitoring the issue of fishing authorisations;
- Adaptation of the fisheries legislation towards the promotion of environmentally friendly fishing techniques;
- Adaptation of fishing effort to the availability of resources;
- Economic operators should be encouraged to apply practise responsible fisheries principles;
- Setting up a programme for the adoption of responsible fishing methods and practices for the shrimp fisheries (including: marine protected areas, increase in mesh size, control and monitoring system, utilization of By-catch Reduction Devices on shrimp trawls);
- Financial and logistic support to the Fisheries Department;
- Establishing at sub-regional level arrangements and, as appropriate,a structure which will facilitate exchange of information on fisheries activities;
- Introduction of By-catch Reduction Device on board shrimp trawlers in order to avoid massive catches of juvenile fish;
- Organisation of fishermen in professional associations;
- Organisation of seminars to increase the awareness of fishermen regarding the fishery laws and regulations;
- Determination of the minimum market size of shrimp and fish;
- Protection of sensitive habitats (nurseries).

## 14. PROPOSAL FOR A PLAN OF ACTION FOR DEVELOPMENT OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES FOR SHRIMP EXPLOITATION AT NATIONAL, REGIONAL AND GLOBAL LEVEL

As for the previous case, proposals for a plan of action for development and implementation of environmentally friendly techniques and practices for shrimp fishing, have been discussed during the workshop. These include the following items:

- Testing of the By-catch Reduction Devices (BDRs) in local conditions before any implementation;
- Feasibility studies on the introduction of By-catch Reduction Devices;
- Studies on socio-economic impact of the utilisation of by-catch on local coastal populations and fishery operators;
- To extend the introduction of BRDs to the sub-region and the region;
- Adaptation of the fisheries legislation in connection to the promotion of environmentally friendly fishing techniques;
- To carry out research for determination of nurseries and to draw the limits of areas to be protected and to map fisheries zones according to fish species to be preserved;
- Preparation of the decree of application of the fisheries law;
- Determination of proper mesh size for shrimp fisheries;

- Establishment of mesh size regulations for various fisheries and/or fish species; implementation of these regulations;
- Collaboration between Merchant Marine and National Navy for the effective implementation of the existing legislation;
- Reduction of fishing effort by reducing the number of vessels authorised to fish shrimp;
- Continuous adaptation of the regulation according to the changes of local conditions and situation;
- Extension work towards fishery operators as appropriate;
- Setting up a co-ordination and control unit for responsible fishery practices and sustainable fisheries;
- Fining defaulters.

## 15. CONCLUSIONS

The shrimp fishing industry in Cameroon is to a certain extent out of the control of the local fishery Authorities: Most of the trawlers, even been owned by nationals, were built abroad; the owners of the vessels are, in general, foreigners, from different countries (Greece, Spain, Morocco, China, etc.), with partnerships with local investors; vessels and fishing gear designs are therefore from various origins. As a result, little is known locally about the fishing technology in use. As recommended in such cases by Vandeville (1990) it could be necessary nowto carry out a number of activities related to: (i) detailed description of different types of trawls used in Cameroon; (ii) selectivity studies for shrimp and fish (even though such studies could be costly); (iii) harmonisation of different technologies used in order to facilitate the controls; (iv) trials of selectivity devices to be installed on the trawls of commercial fishing vessels (while considering that it will anyway take a long time to convince professionals to adopt new devices, including becaause of the additional costs. For this reason, communication and extension work will be critical.

**BIBLIOGRAPHY**

Berrit, G.R., 1961 - Contribution à la connaissance des variations saisonnières dans le golfe de *Guinée. Observations de surface le long des lignes de navigation. Première partie: généralités. Cah. Océanogr.,vol.13, N° 10*: 715-727.

Berrit, G.R.,1962a - Contribution à la connaissance des variations saisonnières dans le golfe de Guinée. Observations de surface le long des lignes de navigation. Deuxième partie: Etude régionale 1. *Cah. Océanogr., vol. 14 N° 9:* 633-643.

Berrit, G.R., 1962b - Contribution à la connaissance des variations saisonnières dans le golfe de Guinée. Observations de surface le long des lignes de navigation. Deuxième partie: Etude régionale 2. *Cah.Océanogr., vol.14, N° 9:* 719-729.

Berrit, G.R.,1966 - Les eaux dessalées du golfe de Guinée. Centre Rech. Océanogr. Abidjan, *Doc. Scient. Prov.* N° 9: 1-15.

Corsi *et al*, 1991; Corsi, F.; Labla, D.; Matthes, H.; Tafani, C., et Vallet, F., 1992 - Contribution au Plan Directeur des Pêches et de l'Aquaculture/ TCP/ CMR/ 0053/FAO:134p.

Crosnier,A., 1964 - Fonds de pêche le long des côtes de la République Fédérale du Cameroun. *Cahiers ORSTOM, N° Spécial*: 133p.

Djama T., 1992 - Interaction between the artisanal and industrial fisheries in Cameroon. Ph.D. thesis, univ.of Wales, U.K.

Garcia,S. 1977 - Biologie et dynamique des populations de crevettes roses *(Penaeus durarum notialis,* Pérez-Farfante, 1967) en Côte d'ivoire. *Trav.Doc.ORSTOM*, Paris, (79): 271 p.

Garcia, S. and L. Le Reste. 1981.Life cycles, dynamics, exploitation and management of coastal penaeid shrimp stocks. *FAO Fish.Tech.Pap.*, (203): 215 p. Issued also in French.

Garcia, S.and F. Lhomme, 1980 - Pink shrimp ressources *(Penaeus duorarum notialis). FAO Fish.Tech.Pap.*, (186.1): 121-45. Issued also in French.

Kébé M.; Njock, J.C. et Gallène, J., 1993. Revue sectorielle de la pêche artisanale maritime au Cameroun. *Programme de Développement Intégré des pêches Artisanales en afrique de l'Ouest (DIPA)*. 30p. et annexes. DIPA/WP/48.

Laure, J., 1969 - La pêche industrielle au Cameroun. Yaoundé, ORSTOM, 126 p.

Laure, J., 1972 - Vingt ans de pêche industrielle au Cameroun. *Pêche Marit.,* (20): 866.

Njifonjou, O., 1997. - Costs and Earnings in Marine artisanal fisheries in the Limbé region, Cameroon, Central Africa. The IDAF NEWSLETTER, N° 33, pp. 6-9.

Njifonjou, O., 1998. - Dynamique de l'exploitation dans la pêche artisanale des régions de Limbe et de Kribi au Cameroun. Thèse de doctorat, Université de Bretagne occidentale, Brest, France; 347p.

Njifonjou, O., 1998. - The Awasha Fishing Fleed in the Cameroon Coastal Area: Profitability Analysis of the Purse Seine Units Activity. *In*: Eide and Vassdal (eds): Proceeding of the 9th International Conference of the IIFET - TromsØ, Norway, 1998, pp. 269-276.

Njifonjou, O.; Folack, J.; Bondja, M.; Njamen, D.; Njock, J.C., 1995. - Enquête-cadre et Etude socio-économique de la pêche artisanale maritime au Cameroun. Document Technique FAO/DIPA N° 38, 66p.

Njock, J.C., 1979 - La pêche industrielle au Cameroun. Bilan et perspectives. *Doc.Sci.Dir.Pêches Serv.Reche.Appl.Docum.Yaoundé, (1):* 41 p.

Njock, J.C., 1985 - La pêche démersale au Cameroun et ses tendances actuelles. Revue science et technique. Limbé, Station de Recherches Halieutiques, 30 p. (mimeo)

Njock, J.C., 1990 - Les ressources démersales du Cameroun: Biologie et exploitation des principales espèces ichtyologiques. Thèse de Doctorat en Sciences présentée à l'Université d'Aix - Marseille 2: 187p.

Njock, J.C., 1996 - Proposition d'action et analyse des données scientifiques et techniques, pour une meilleure connaissance et une gestion des ressources aquatiques. TSS1 - GAB/95/01T-COREP/PNUD/FAO: 74 p.

Njock, J.C., 1997 - Rapport du séminaire national sur l'aménagement et le développement de la pêche artisanale au Cameroun. *Programme pour le Développement Intégré des Pêches Artisanales en Afrique de l'Ouest* (DIPA). Cotonou, Bénin, 64 p. DIPA/WP/113.

Seidel, W.R., 1979 - Development of a sea-turtle excluder shrimp trawl. ICES CM/B, 28: 8p.

Ssentongo, G.W. and Njock., J.C., 1987 - Marine fishery Ressources of Cameroon: A review of exploited fish stocks. *CECAF/ECAF SERIES* 87/44: 71 p.

Vendeville, P., 1990 - Tropical Shrimp Fisheries: Types of fishing gears used and their selectivity. *FAO Fisheries technical Paper*. N°. 261 (Rev.1). Rome, FAO, 1990. 75p.

Williams, F.,1968 - Report on the Guinean Trawling Survey. OAU Scientific,Technical and Research Commission. Lagos. Publ. N° 99: 828p.

## ANNEXE 1

### Research and Observation Mission Report on Shrimp Trawling Fisheries.

By

Dr. O.Njifonjou, Fisheries Socio-economist Researcher
Dr. P.N. Meke Soung, Fisheries Head of Services Douala

## INTRODUCTION

A research and observation mission was carried on from 21 to 24 September 1999 on board of ANDELA IX, a shrimp fishing trawler belonging to SCLM, CAMECRUS Fishing Company, P.O. Box 3751 Douala. This mission was carried out in preparation of the seminar on the adoption of environmentally friendly techniques and practices used in tropical shrimp trawling fisheries.

### 1. The objectives of the mission

- To identify and evaluate by-catch and discards from shrimp fishing trawls;
- To observe fishing activities in Cameroonian waters.

### 2. Characteristics of fishing boats and fishing methods

The shrimp fishing trawler ANDELA IX, an outrigger trawler, uses as most fishing boats of the CAMERUS companyethe so called locally "American Fishing Method " or twin trawling consisting in four trawls 20 to 22 m long, with 30 mm stretched mesh size at the codend. According to the captain of the vessel the technique of using 4 nets was adopted only recently but allows more efficient shrimp fishing compared to the traditional system using two nets more appropriate to fishing in shallow waters.

In compliance with the objectives of the mission, three fishing grounds were explored by the boat captain ADJEDJI Parfait Grégoire :

- the fish exclusive zone situated in the sandy or muddy bottoms, between 12 and 18 m depths;
- the intermediary fish and shrimp zones at depths situated between 19 and 27 m;
- the shrimp exclusive zone at dephts beyond 30 m.

In each of the three zones explored, samples of discards were collected in four bags of 20 kg each. The content of each bag was examined later on to determine the composition and to measure the length frequency distribution of the various species caught.

### 3. Observations

The following observations were made:

- generally trawls are left in the water six times per day for a duration of 3 hours each time;
- discards constitute 70% of the total catch of the trawl;
- discards comprise solid marine wastes and debris, juvenile and all the low value fish not useful to the company;
- fish discards from the first zone comprise mainly belts, shad, crabs and a small quantity of machoirons, bars, grey shrimp, raies, small soles,
- in the second zone, shad are found in the greater numbers followed by belts, crabs, barbillon, caranx, turbos, soles, bossus, etc.
- less shad are found in the third zone where discards comprise mainly fritures disque, barbillon, soles, pink shrimp, etc.
- during the three-day mission, nearly 2 000 kg of marketable fish and 60 kg of marketable shrimp were caught. This gives a ratio of 1 kg of shrimp for 33 kg of fish;
- the small quantity of shrimp caught was probably due to fact that the trip was made off the right season which normally runs from March to September. Generally the ratio of shrimp to

fish at the end of a tide ranges from 1 / 20 to 1 / 25 (according to boat landings, therefore without considering the discards at sea).

- according to the crews, landed products are processed, packaged and frozen on board ready for sale in the local market in case of fish and/or for export in case of shrimp;
- actually fish caught are grouped into 9 commercial categories. These include: average size bars, small size bars, average size soles, small size soles, others, big fish species, fritures, MIX 3, raies and sharks.
- two species of shrimp are exploited, the grey shrimp (*Penaeus kerathurus*) and the pink shrimp (*Penaeus notialis*), which are sold after grading from zero to seven according to sizes;
- grey shrimp corresponds to the grade with the lowest value (it is sold mainly in the local market and in neighbouring countries) and constitutes 70% of the shrimp total catch;
- depending on the criteria used to sort out and grade catches, fish of low value represent up to 70% of total landings.

## 4. Activities carried out on fishing grounds.

Vessels of various origins and several types of fishing are in use in the Cameroonian coastal waters.

### 4.1 Piracy of Cameroonian waters.

It is easy to observe and identify some piracy activities using radio messages and binoculars. The captain mentioned several foreign fishing vessels exploiting the Cameroonian coastal waters without any fear.

### 4.2 Pair trawlers (2 boats trawling one net; not to be confused with "twin trawling" which consists in using two trawls side by side on each side of the outrigger trawler)

This type of fishing is becoming more common in Cameroonian coastal waters, especially in the shallower coastal section, thus competing with artisanal fisheries It involves two fishing vessels pulling the same trawl. They are separated by a long distance (300 to 500 m) and drive the fish towards the trawl with their drag, propeller noise and warps vibration. This method of fishing, observed in Limbé makes it difficult to implement sustainable management scheme of resources. As vessels are small, they can exploit shallow waters (2-6 m) near the coast line. The trawl opening is practically from the bottom to the surface (floats are above the water while the codend sweeps the bottom). In this way benthic, demersal and pelagic species may all be caught together. The meshes of the trawls are of small sizes which does not spare juvenile fish. This fishing system is commonly called "sweeping net" in Limbé area

### 4.3 Conflicts between artisanal and industrial fishing

Currently, the same fishing grounds are exploited by artisanal and industrial fisheries, despite the fact that fishing laws prohibit trawl fishing within the three nautical miles zone. During a 3-days trip on board the industrial shrimp trawler, it seems that nets belonging to artisanal fishermen were hit 4 times according to sudden, unexpected, tension on trawling equipment. It is worth observing that the captain does not normally report these events and because of this, the artisanal fishermen cannot be compensated for the loss of their nets.

## 5. Analysis of the discard samples

A total of 67 kg of discards were taken to the SRHOL-IRAD laboratory for analysis in order to determine the composition, identify the different species, using FAO species identification key, and analyse the length frequency distribution of the various species.

Two categories of fish were identified in the discards :

- the low value by-catch totally discarded (ceinture, *Ilisha africana*, crabs), and
- the juveniles of marketable fish.

### 5.1 Composition of the samples

The composition of the samples analysed in the SRHOL-IRAD laboratory is as follows:

| | |
|---|---|
| - marin debris | 21% |
| - ceintures | 16% |
| - crabs | 13% |
| - *Ilisha africana* | 8% |
| - other juvenile fish | 42% |

### 5.2 Specific composition

The analysis of specific composition of the samples shows that nearly 40 different species are caught and discarded.(see Table 1).

**TABLE 1: Various species identified in the discards of shrimps fishing trawlers**

| N° | Common name | Family name | Scientific name |
|---|---|---|---|
| 1. | Soles | Soleidae | *Synaptura* sp. |
| 2. | | Cynoglossidae | *Cynoglossus senegalensis* |
| 3. | Bonga (sardine) | Clupeidae | *Sardinella maderensis* |
| 4 | | | *Ethmalosa fimbriata* |
| 5. | Bars | Scianidae | *Pseudotolithus senegalensis* |
| 6. | | | *P. typus* |
| 7. | | | *P. elongatus* |
| 8. | Petits capitaines | Pomadasyidae | *Pomadasys rogeri* |
| 9. | | | *Galoides decadactylus* |
| 10. | | | *Polydactylus* sp. |
| 11. | (Fritures) | | *Brachydeuterus auritus* |
| 12. | Grands capitaines | Polynemidae | *Pentanemus quinquarius* |
| 13. | Disque | | *Drepana africana* |
| 14. | Fritures | | *Eucinostamus melanopterus* |
| 15. | | Tetradontidae | *Lagocephalus laevigatus* |
| 16. | | Bagridae | *Chrysichtis negrodigitatus* |
| 17. | Carangues | Carangidae | *Selen dorsalis* |
| 18. | | | *Alectis alexandrinus* |
| 19. | | | *Caranx hippos* |
| 20. | | | *Caranx senegalus* |
| 21. | | | *Chlorocombrus chrysurus* |
| 22. | | | *Trachurus* sp. |
| 23. | Ceintures | | *Trichurus lepturus* |
| 24. | Raies | Rajidae | *Raja miraletus* |
| 25. | | Dasyatidae | *Dasyatis margarita* |
| 26. | Barracuda | Sphyraenidae | *Sphyraena piscatorium* |
| 27. | | Sparidae | *Pagellus* spp. |
| 28. | | | *Dentex* spp. |
| 29. | Rasoirs | Clupeidae | *Ilisha africana* |
| 30. | Crabs | Calapidae | *Calappa rubroguttata* |
| 31. | | Squillidae | *Squilla aculeata calmani* |
| 32. | | Portunidae | |
| 33. | Mulets | Mugilidae | *Mugil* spp. |
| 34. | | | *Mugil capunil* |
| 35. | Seiche | Sepiolidae | *Sepia* spp. |
| 36. | Shrimps | Peneidae | *Penaeus notialis* |
| 37. | | | *P. keraturus* |
| 38. | Carpes | Lutjanidae | *Lutjanus* spp. |
| 39. | Congres | | *Conger* |
| 40. | Machoiron | Ariidae | *Arius heudeloti* |
| 42 | Ceintures | | |
| 43 | Sharks | | |

Size and weight frequencies of species found in discards

The measurements of size and weight of each species found in discards were noted. Results of the analysis of these measurements are presented in Tables 2 and 3. Table 2 shows minimum and maximum weights by species. The weight of individual fish which are discarded ranges from 1.6 to 127.8 g. Table 3 shows the distribution of size frequencies by species.

**TABLE 2. Minimum and maximum weight (g) of fish discarded**

| | *Brachyde -terus auritus* | *P. typus* | *P.senega- Lensis* | *Cynoglos- sus spp.* | *Drepana africana* | *Pentane- mus quinqua- rius* | *Polydactylus quadrifilis* | *Chloros- combrus chrysurus* | *Turbot* | *Selene dorsalis* |
|---|---|---|---|---|---|---|---|---|---|---|
| **Smallest fish** | 5,5g | 4g | 10,3g | 7,2g | 8,3g | 8,9g | 7,9g | 21,1g | 8,3g | 1,6g |
| **Bigest fish** | 37,1g | 42,2g | 25,5g | 104,2g | 54,6g | 39,9g | 38,5g | 34,9g | 35,9g | 127,8g |

## 6. Conclusions and recommendations

### a) Observations

- Juvenile fish constitute 80% of discards from shrimp trawlers;
- small fish (MIXIII category and friture) constitute nearly 70% of landed product;
- some fishing practices (use of pair trawling) have a potentially negative effects on resource;
- foreign pirate vessels steal our resources because of lack of an efficient system for controlling and monitoring coastal waters;
- shrimp trawlers catch more fish than shrimp because they can fish during shrimp season (April to September), in fish and shrimp exclusive zones and mixed zones;
- fishing law authorises shrimp trawlers to use 33 mm mesh nets while the legal mesh size for fish trawlers is 44 mm;
- shrimp trawlers fish six months per year, half of this time is used to fish or exploit fish exclusive zones;
- fishing gear belonging to artisanal fishermen may, rather frequently, be hooked by the trawl of a shrimp fishing vessel; the conflicts opposing artisanal to industrial fisheries are indeed frequetn and important.

### b) Recommendations for a sustainable management of fisheries resources

- to develop an integrated plan with measures aiming to reduce by-catch and to prevent juvenile catches including, first of all, the enforcement of existing fishing law regarding mesh size and, at the same time, an increase of the mesh size of trawl nets to be used in industrial fisheries;
- adoption of technological devices such as by-catch reducing devices;
- strict respect of fishing zones restricted to specific types of fisheries;
- to impose measures designed to prevent fishing practices which do not comply with the Code of Conduct for responsible fisheries;
- to revise fishing legislation which makes a distinction between shrimp trawlers and other trawlers (fishing permits, licences, etc.);
- to reinforce the fishing control and monitoring system in territorial waters of Cameroon;
- to prescribe minimum market size for the various fish species in order to reduce the actual marketing of too small fish (filling, at the same time, the gaps observed in the current fisheries regulations);
- to take legal measures to seize by-catch and shrimp discards sold through various marketing channels.

**TABLE 3: Length-Frequency distribution of the main species of the discards sample collected during the 21-24 September 1999 trip on board ANDELA IX**

| Total length (cm) | *Brachydeterus auritus* | *P. typus* | *P.senegalensis* | *Cynoglossus* spp. | *Drepana africana* | *Pentanemus quinquarius* | *Polydactylus quadrifilis* | *Chloroscombrus chrysurus* | *Turbot* | *Selene dorsalis* |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,5 | | | | | | | | | | 2 |
| 5 | | | | | | | | | | 4 |
| 5,5 | | | | | | | | | | 3 |
| 6 | | | | | | | | | | 6 |
| 6,5 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 7,5 | | | | | 1 | | | | | |
| 8 | 4 | 2 | | | 4 | | | | | |
| 8,5 | | 1 | | | 2 | | | | | |
| 9 | 12 | | | | 12 | | | | | |
| 9,5 | 6 | 2 | | 1 | 8 | | 2 | | | |
| 10 | 11 | 3 | | | 5 | | 3 | | 3 | |
| 10,5 | 1 | 3 | | | 4 | | 2 | | 2 | |
| 11 | 21 | 3 | 2 | | 2 | | 3 | | 4 | 2 |
| 11,5 | 4 | 2 | 1 | 1 | 2 | | 4 | | 3 | |
| 12 | 12 | 10 | 2 | 2 | 4 | 1 | 3 | 1 | 3 | |
| 12,5 | 2 | 1 | 1 | 1 | 1 | | 5 | 1 | 2 | |
| 13 | 6 | 10 | 5 | | 2 | 2 | 6 | 1 | 3 | |
| 13,5 | | 4 | 1 | 1 | | 2 | 3 | 1 | 2 | |
| 14 | 4 | 19 | 4 | | | 2 | 2 | 14 | 2 | |
| 14,5 | | 3 | 3 | | | | | 4 | 1 | |
| 15 | 1 | 7 | 1 | 3 | | | | 4 | 2 | |
| 15,5 | | | | 1 | | | 1 | 1 | 1 | |
| 16 | 1 | 10 | | 3 | | 8 | | | 1 | 1 |
| 16,5 | | 1 | | 2 | | 2 | 1 | | 1 | |
| 17 | | 7 | | 1 | | 1 | | | | 8 |
| 17,5 | | | | 4 | | | | | | 5 |
| 18 | | 2 | | 4 | | 3 | | | | 14 |
| 18,5 | | | | 3 | | | | | | 6 |
| 19 | | | | 1 | | | | | | 3 |
| 19,5 | | | | 2 | | | | | | 1 |
| 20 | | 1 | | 5 | | | | | | 2 |
| 20,5 | | | | 1 | | | | | | 1 |
| 21 | | | | 3 | | | | | | 3 |
| 21,5 | | | | | | | | | | 2 |
| 22 | | | | 2 | | | | | | 1 |
| 22,5 | | | | 2 | | | | | | |
| 23 | | | | 5 | | | | | | 1 |
| 23,5 | | | | 2 | | | | | | 1 |
| 24 | | | | | | | | | | |
| 24,5 | | | | | | | | | | |
| 25 | | | | 1 | | | | | | |
| Total | 85 | 91 | 20 | 51 | 47 | 21 | 35 | 27 | 30 | 66 |

## ANNEXE 2

## WORKSHOP
## (Douala, 27-29 September 1999)

### 1. BACKGROUND

Within the GEF/UNEP/FAO Project development and preparation phase, each participating country designated a national Coordinator whose role is to consult all the stakeholders to gather up to date information concerning shrimp trawling fisheries, perception of the situation and of possible changes. To this effect, a workshop was organized and chaired by Dr. J.C. Njock, the National Coordinator of the project in Cameroon. This event took place in Douala, from 27 to 29 September 1999.

### 2. OBJECTIVE OF THE WORKSHOP

The primary objective of the workshop was to gather information on Knowledge, Attitude and Perception of stakeholders regarding current shrimp fishing techniques and policies as well as new ones considered to be environmentally friendly.

### 3. PARTICIPANTS AND ACTIVITIES

The participants at the workshop were representatives of researchers, public decision-makers, fisheries professionals, and national NGOs. The Ministry of Environment and Forestry, and international NGOs, especially WWF and UICN, were invited but did not attend the workshop.

The discussions were centred around Knowledge, Attitude and Perception of participants concerning current shrimp fishing techniques and policies, and a by-catch reducing device considered to be environmentally friendly.

A number of communications were made during the workshop to enlighten participants on the following topics:

(i) The present situation of the Fisheries sector in Cameroon;
(ii) The impact shrimp fisheries on marine environment and resources in Cameroon;
(iii) Analytical description and life cycle of shrimp species in tropical marine environment;
(iv) Possible solutions for the reduction of juvenile fish and shrimp;
(v) Evolution of the volume of catches in Cameroon; and
(vi) Presentation of industrial fisheries activities.

Participants were organised in 4 working groups as follows:

* Group 1: Representatives of Public Administration;
* Group 2: Representatives of Research Institutions;
* Group 3: Representatives of Industrial Fisheries and Environmental NGOs;
* Group 4: Representatives of Artisanal Fisheries and NGOs of the Fisheries Sector.

### 4. RESULTS OF THE WORKSHOP

Conclusions of discussions held during plenary sessions are summarised below as Knowledge, Attitude and Perception of the public administration, research institutions, artisanal fisheries frofessionals, operators in the fishery industrial sector and NGOs, concerning current shrimp fishing techniques and policies and the introduction of by-catch reduction devices as environmentally friendly practice.

The knowledge of the various groups of participants was expressed in terms of their experience and constraints related to current shrimp fishing techniques and policies. Recommendations formulated for improvement were noted. Their attitude and perception about the by-catch reduction devices which the project may try to introduce were also registered. These results are presented in the following tables.

## 4.1 PARTICIPANTS KNOWLEDGE OF CURRENT SHRIMP FISHING PRACTICES AND POLICIES.

### 4.1.1 The administration's knowledge

| Experience related to fishing practices and policies | Constraints related to fishing practices and policies | Recommendations |
|---|---|---|
| - Training of fisheries extension agents<br>- **Health and veterinary inspection of fisheries products and related regulation**<br>- Procedures for issuing fishing licences and permits<br>- Running of 'Fisheries checkpoints' and control centres<br>- Knowledge of fisheries regulation, related decrees of application; Tax system<br>- Running of Provincial fisheries services<br>- Administration of the sector in general<br>- Baseline survey of fishing settlements | - Ignorance of the shrimp species biology<br>- Lack of knowledge on fish stock<br>- Inadequate fishing agreements with countries which have abundant fisheries resources<br>- Insufficient funding and inadequate equipment for the Fisheries Department<br>- Inadequate enforcement of fisheries law and monitoring of fisheries activities<br>- Insufficient qualified staff for the Fisheries Department | - Valorisation of by-catch<br>- Provision of financial support for the Fisheries Department<br>- Mapping of fisheries zones according to fish species<br>- Assessment of fish stock<br>- Identification and demarcation of nurseries areas<br>- Preparation of the decree of application of the fisheries law |

### 4.1.2 Researchers knowledge

| Experience related to fishing practices and policies | Constraints related to fishing practices and policies | Recommendations |
|---|---|---|
| - Research efforts to determine the proper mesh size for shrimp fishing<br>- Baseline survey of shrimp fisheries<br>- Studies on fishing gear technology<br>- Utilisation of beam trawlers with 2 or 4 nets<br>- Utilisation of nets with 30 - 40 mm mesh size<br>- Increase in fishing effort (number of boats and duration of fishing)<br>- Reduced CPUE<br>- Reduced fish size<br>- The life expectancy of *Penaeus notilis* ranges from 20 to 24 months<br>- The life cycle of *Penaeus notilis* is known<br>- Massive catch of juvenile fish<br>- Increasing conflicts among fisheries operators<br>- Increasing quantity of discarded fish | - Lack of collaboration between various actors of the fisheries sector<br>- Ignorance of the proper mesh size for shrimp fisheries<br>- Lack of control of fisheries activities<br>- Lack of data on physico-chemical parameters<br>- Inadequate scientific research on shrimp species<br>- Reduced fishing depth<br>- Lack of sub-regional organisation to facilitate the exchange of fisheries information<br>- Lack of a master plan for the management of fisheries resources<br>- Massive catch of juvenile fish | - Setting up an organ that facilitates collaboration between the various actors of the fisheries sector<br>- Determination of proper and compulsory mesh size for shrimp fisheries<br>- Control of fishing activities<br>- Definition of shrimp fishing depth<br>- To collect data on physico-chemical parameters of the environment<br>- To carry out research on shrimp species<br>- To create a sub-regional organ which will facilitate exchange of information on fisheries activities<br>- To introduce the by-catch reducing device in order to avoid massive catch of juvenile fish |

### 4.1.3 Artisanal Professionals and Local NGOs Knowledge

| Experiences | Constraints | Recommendations |
|---|---|---|
| - Destruction of the artisanal fishing gear by the trawlers<br>- Frame surveys of 1995 in the entire coastal zone and 1999 in the Fako<br>- Fishing of the small estuary shrimp *Nematopaleamon hastatus*<br>- Collection of fisheries statistics<br>- Exploitation of the mangroves for fuel wood<br>- Existence of three major methods of fishing Bottom Gill Net (BGN), Surface Gill Net (SGN) and Purse Seine (PS)<br>- Targets species differ according to different types of fishing gear (PS, BGN, SGN etc.) | - Non respect of the regulations by the industrial sector<br>- Destruction of the nurseries<br>- Massive exploitation of the juveniles by trawlers<br>- Lack of awareness of fishermen on the fisheries laws and regulations<br>- Conflicts between Artisanal and Industrial fisheries<br>- Unorganised market for fisheries products<br>- Destruction of mangrove for fuel wood consumption<br>- Non respect of the fishing zone limits by the industrial fisheries<br>- Destruction of the artisanal fishing gear by the<br>- Trawlers | - Protection of the mangroves<br>- Control of the fishing operations<br>- Involvment of the fisherfolk in decision making<br>- Facilitate fishermen to be organised in associations and cooperatives<br>- Providing of credit facilities<br>- Organisation of seminars to sensibilise fishemen on the fishing laws and regulations<br>- Establishment of permisible mesh size<br>- Look for funding to train fishermen and trainers |

### 4.1.4 Knowledge of the Industrial Professionals and NGOs interested in Environment

| Experiences related to fishing practices and policies | Constraints | Recommendations |
|---|---|---|
| - Trawling system with 2 or 4 nets<br>- Duration of one trawl: 3h<br>- Fish is landed in a hall and put in cold stores<br>- Commercialisation of shrimp: 94% for export and 6% for the local market<br>- Type of gear respecting the international regulation of Geneva<br>- The processing is done on board by deeping it in a sodium metalsulfite solution, grading and freezing.<br>- Self funding and Taxe-free of the fishing equipment<br>- Daily total production of a trawler: 200kg | - Piracy of the Cameroonian waters by foreign vessels<br>- Reduction of the average size of shrimp caught<br>- Decrease in the shrimp production<br>- High taxation of the production<br>- Unavailibility of fishing materials and electronic equipment<br>- Unselective gears<br>- Long administrative procedures for shrimp exportation | - The Research Institute must be equipped with adequate research vessels<br>- Merchant Navy and National Navy should collaborate to effectivelly implement the existing legislation<br>- Determination of the minimum market size of shrimp and fish<br>- Regulations on the mesh size of gears<br>- Monitoring the issuing of the Fishing Agreements<br>- Determination of the exclusivity zone<br>- Determination of the fishing zone limits according to the size of vessels<br>- The artisanal fishing net represents the real danger for trawlers and traps for fish. This include the respect of the regulation<br>- Prohibition of the twins trawlers<br>- Effective control and monitoring<br>- Reduction of the fishing effort by limiting the number of vessels autorised to fish shrimp. |

## 4.2 ATTITUDE

### 4.2.1 Attitude of Administration and Research

| Interests/Wish | Other proposed solutions |
|---|---|
| - Increase in the size of shrimps caught<br>- Reduce volume of by-catch<br>- Protection of aquatic biodiversity<br>- Testing of BRDs locally | - Mesh size regulation<br>- Control and monitoring of fishing operations at sea<br>- Protect sensitive habitats (nurseries)<br>- Adapt fishing effort to the availibility of resouces |

### 4.2.2 Attitude of Professionals and NGOs of the Artisanal Fisheries sector

| Interests/Wish | Fears / Consequences | Recommendations |
|---|---|---|
| Facilitate reconstitution of the stock of fish exploited | Reduced revenues of fish traders, due to the decrease in by-catch | To find out a source of funds for the alternative activities |

### 4.2.3 Attitude of Industrial Fsheries, Professionals and NGOs interested in Environmental Protection

| Interests/Wish | Fears/Consequences | Recommendations |
|---|---|---|
| - Better resource management and conservation | - Interested costs of fishing due to the introduction of the BRDs<br>- Opportunity cost due to the reduction of by-catch<br>- Absence of adequate control and monitoring of the sea water<br>- Dwarf species constitute 1/3 of the actual production of the trawlers | - Renegotiation of the contracts with our partners (banks, administration, etc..)<br>- Setting up a compensatory system<br>- Setting up a control and monitoring system of the sea |

## 4.3 PERCEPTIONS

### 4.3.1 Perception of the Administration

| BRDs | Research action | Professionals action |
|---|---|---|
| - Recommend the introduction of the BRDs<br>- Funds needed for:<br>* Feasibility studies<br>* Putting on the BRDs<br>* Sensitizing and training on the use of BRDs<br>* Drafting a bill to regulate the use of BRDs | - Good collaboration between Administration, Research and Professionals<br>- Provide funds to test BRDs | - Recurrent lost must be recovered<br>- Professionals must sacrify a profit aspect of their activity for the stock reconstitution<br>- Professionals must be well organised to facilitate the application of the BRDs |

### 4.3.2 Perception of the Research

| BRDs | Administration action | Professionals action |
|---|---|---|
| - In favor of BRDs | - Good valorisation of the fisheries sector<br>- Reinforcement of the existing regulations and laws<br>- Reinforcement of Control and monitoring fisheries<br>- Reinforcement of the collaboration between the various actors of the sector<br>- Excessive issuing of the fishing licences and permits | - Reinforcement of the collaboration with the professionals |

### 4.3.3 Perception of the Professionals

| BRDs | Administration action | Research action |
|---|---|---|
| - Accept the introduction of BRDs<br>- Testing required<br>- Setting up back stopping measures | - Reinforcement of the collaboration with Professionals<br>- Adequate regulation adapted to the new situation<br>- Training of fisheries Professionals<br>- Setting up a coordination and control unit<br>- Fining of defaulters | - Data on fish stock available<br>- Reseach activities are unknown<br>- Reinforcement of the Collaboration between Research and Professionals |

## 5. RECOMMENDATIONS

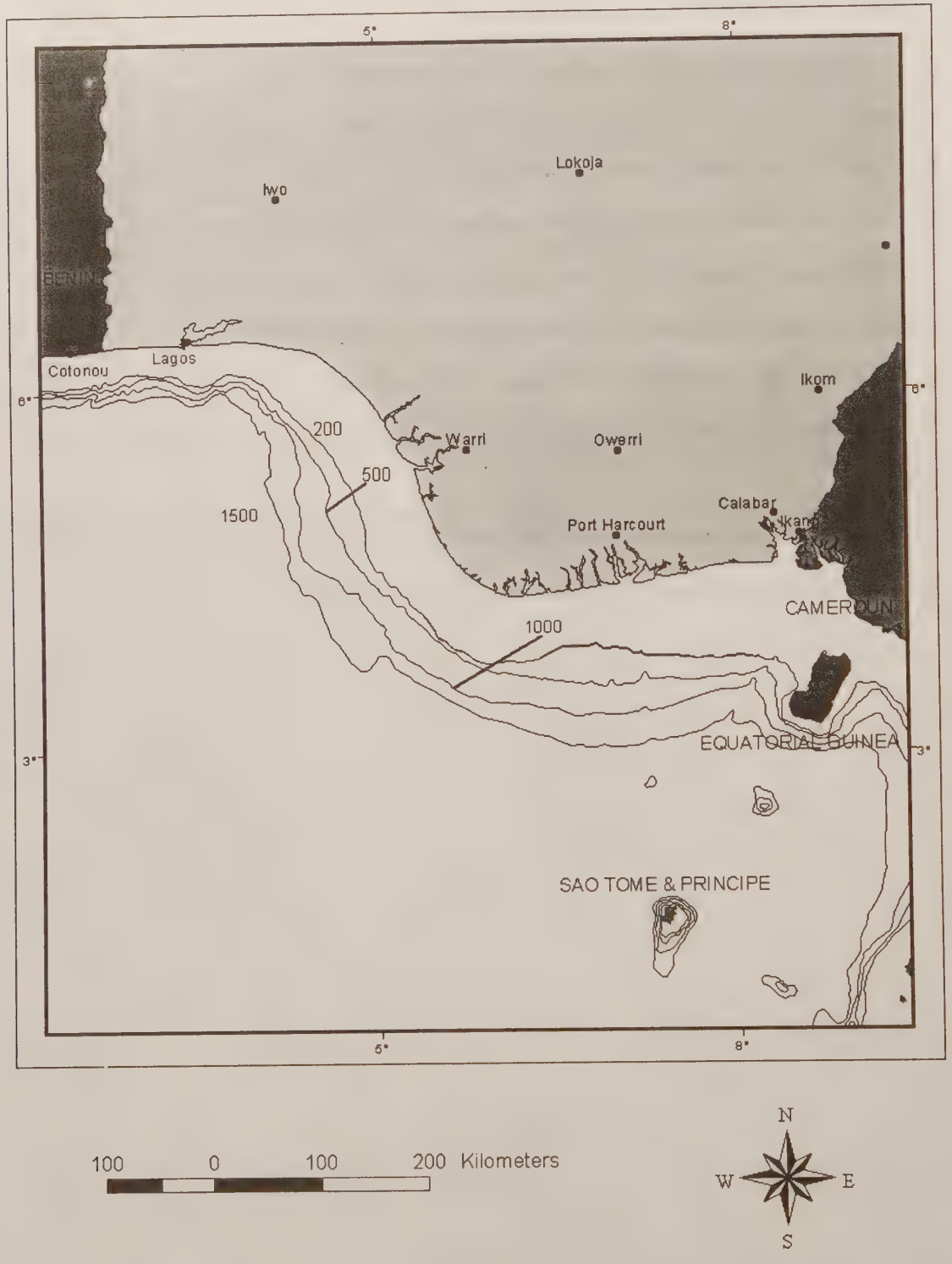
The participants in the workshop unanimously agreed on the principle of the introduction of By-catch Reducing Devices (BRDs) in the shrimp fisheries, and recommend the following :

1. Implication of all the stakeholders including decision makers, research institutions and professionals in the process of adoption;
2. Testing of the BRDs before any implementation;
3. Assessment of the shrimp stock (in terms of quantity and potential value);
4. Studies on socio-economic impact of the utilisation of by-catch
5. Feasibility studies of the introduction of BRDs;
6. Extend the introduction of BRDs beyond the country to the sub-region and the region;
7. Enforcement of control and monitoring of fishing operations at sea;
8. Encouragement of theeconomic operators to implement responsible fisheries
9. Reduction of the rate of increase of the issue of fishing licences;
10. Adaptation of the fisheries legislation towards the promotion of environmentally friendly fishing techniques;
11. Setting up a programme for the adoption of methodes and practices for responsible shrimp fisheries (including: increase of mesh size, control and monitoring system , adoption of BRDs..);
12. These recommendations should be translated into concrete actions.

NIGERIA

## REDUCING THE IMPACT OF TROPICAL SHRIMP TRAWLING FISHERIES ON THE LIVING MARINE RESOURCES THROUGH THE ADOPTION OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES IN NIGERIA

by Mr. J.C. Ogbonna; National Coordinator (Federal Ministry of Agriculture. Water Resources and Rural Development Depart. of Fisheries; Wuse zone 1, Abuja, Nigeria)



Abstract

The shrimp catch was 10 807 t in 1997, pink shrimp (*Penaeus notialis)* being the most common shrimp species while, with the increase in demand, shallow water brown shrimp are now caught in larger quantities.

Vessels are using trawls with 44 mm mesh size in the codend and are, theoretically, using the Turtle Excluder Device (TED). Bycatch of fish occur, but discard ratios are not known.

The small-sized fish caught by the shrimping vessels are sold at local markets, fresh, smoked or dried by women.

In 1999, 187 vessels were licensed for inshore shrimp fishing. The major companies with large fleets are joint-ventures. All are grouped within a "Nigerian Trawler Owners' Association" (NITOA).

There is no regulation regarding fishing season. The increasing illegal fishing for brown shrimp within the five nautical miles non-trawling zone gives rise to conflicts with artisanal fishers. Landing of all catch is mandatory in Nigeria.

The Nigerian coastal waters are most probably over-exploited with regard to shrimp resources; the breeding grounds/nurseries of commercially important fish/shell fish species are affected; large quantities of juvenile fish are caught.

Resumen

En 1997, las capturas de camarón fueron de 10.807 toneladas métricas. La especie más común es el camarón rosado (*Penaeus notialis*), sin embargo, debido al incremento de la demanda, actualmente el camarón marrón de aguas poco profundas está siendo capturado en grandes cantidades.

Las embarcaciones emplean redes de arrastre con abertura de malla de 44 mm en el copo y, teóricamente, emplean dispositivos exclusores de tortugas (TED: Turtle Excluder Device). Ocurre captura de pescado como fauna de acompañamiento, pero se desconoce la proporción descartada.

Las especies de pescado de menor tamaño, capturadas por las embarcaciones camaroneras, son vendidas frescas, ahumadas o secadas por las mujeres de la zona, en los mercados locales.

En 1999, se otorgaron licencias a 187 embarcaciones para la pesca de camarón de orilla. Las principales compañías, con las mayores flotas, son de riesgo compartido (joint venture). Todas las empresas están agrupadas dentro de la Asociación Nigeriana de Dueños de Arrastreros ("Nigerian Trawler Owners' Association" - NITOA).

No existen regulaciones con relación a las temporadas de pesca. El incremento de la pesca ilegal del camarón marrón dentro las cinco millas náuticas, en las cuales no está permitida la pesca de arrastre, a levantado conflictos con los pescadores artesanales. En Nigeria, el desembarco de todas las capturas es obligatorio.

Los recursos camaroneros de las aguas costeras nigerianas son quizás los más sobre-explotados; los criaderos de las especies de pescados y moluscos, comercialmente importantes, están afectados y se capturan grandes cantidades de peces juveniles.

## 1. INTRODUCTION

Nigeria lies between Lat. 4° 16' –13° 52 'N and Long. 2° 49' –14° 37' E and has a coastline of about 850 km which borders the Atlantic Ocean in the Gulf of Guinea. The limits of Nigeria's territorial waters and Exclusive Economic Zone (EEZ) are 12 nml and 200 nml respectively (i.e. 22 224 km and 370.40 km). The total area of the continental shelf is approximately 41 000 km² (Domain, 1980) but the flats are interrupted coast-wide by unburied fossil corals at about ~40-120 m depth (Allen and Wells, 1962; Awosika, 1990); Canyons off Lagos, Mahin and Calabar also interrupt the shelf (Allen,

1964). Apart from these interruptions and some off shore oil prospecting installations, which now constitute a kind of obstacle for trawling, but sanctuaries for some finfish resources, the shelf is considerably trawlable. Table 1 below indicates the extent of the continental shelf off East of Lagos to between Kwa Iboe and Cross River (Tobor, 1995). Figures 1 and 2 show the location of estuaries and major coastal settlements and Nigerian continental shelf with depth contours.

**TABLE 1: Widths of continental shelf off major river mouths and coastal areas**

| LINE | COORDINATES | SHELF WIDTH (NML) | COASTAL AREA |
|---|---|---|---|
| 1. | 6° 25'N, 3° 24'E | 18 | Off East of Lagos |
| 2. | 6° 23'N, 4° 11'E | 20 | Off Lekki |
| 3. | 6° 13'N, 4° 36'E | 20 | Mahin Mud Coast |
| 4. | 5° 46'N, 5° 05'E | 30 | Benin River Estuary |
| 5. | 5° 27'N, 5° 14'E | 29 | Forcados River Estuary |
| 6. | 5° 90'N, 5° 24'E | 26 | Ramos River |
| 7. | 4° 45'N, 5° 33'E | 32 | Pennington River |
| 8. | 5° 43'N, 5° 42'E | 31 | Fishtown River |
| 9. | 4° 26'N, 5° 58'E | 33 | Sangana River |
| 10. | 4° 17'N, 5° 06'E | 36 | Brass River |
| 11. | 4° 00'N, 5° 06'E | 30 | St. Nicollas River |
| 12. | 4° 23'N, 6° 42'E | 35 | Satabarara River |
| 13. | 4° 23'N, 7° 06'E | 40 | Bonny River |
| 14. | 4° 25'N, 7° 19'E | 40 | Imo River |
| 15. | 4° 27'N, 7° 34'E | 42 | Kwa Iboe |
| 16. | 4° 32'N, 7° 59'E | 43 | Between Kwa Iboe and Cross River |

Source: Tobor J.G., 1995

Nigeria has a population of about 112.1, million. The domestic fish production hovers around 400 000 metric tons (MT). The fish demand figure for 1997 is 1.27 million MT (Table 2 below). There is thus a wide gap between fish demand and production. Nigeria thus spends over 200 million US$ annually on importation of frozen fish to augment the short fall. Even with such high expenditure of scarce foreign exchange on importation of fish, the gap can only be narrowed and not closed.

**TABLE 2: Projected population and fish demand (1996-2008)**

| YEAR | POPULATION (MILLION)* | FISH DEMAND (MILLION TONNES) |
|---|---|---|
| 1996 | 102.6 | 1.23 |
| 1997 | 105.7 | 1.27 |
| 1998 | 108.8 | 1.31 |
| 1999 | 112.1 | 1.35 |
| 2000 | 115.5 | 1.39 |
| 2001 | 118.9 | 1.43 |
| 2002 | 122.5 | 1.47 |
| 2003 | 126.2 | 1.51 |
| 2004 | 130.0 | 1.56 |
| 2005 | 133.9 | 1.61 |
| 2006 | 137.9 | 1.65 |
| 2007 | 142.0 | 1.70 |
| 2008 | 146.3 | 1.76 |

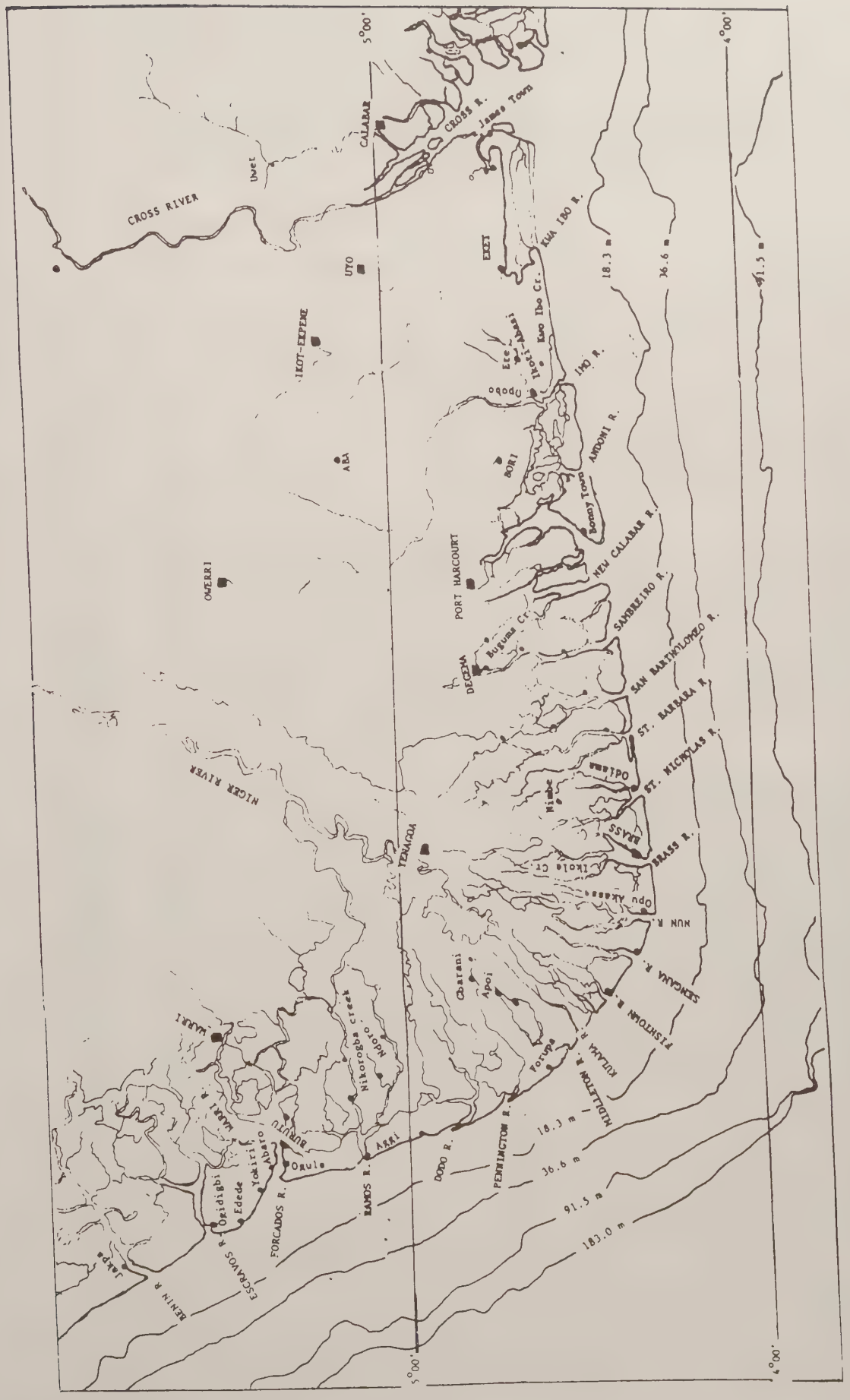



**Figure 1. Location of estuaries and major coastal settlements with good fishing prospects**

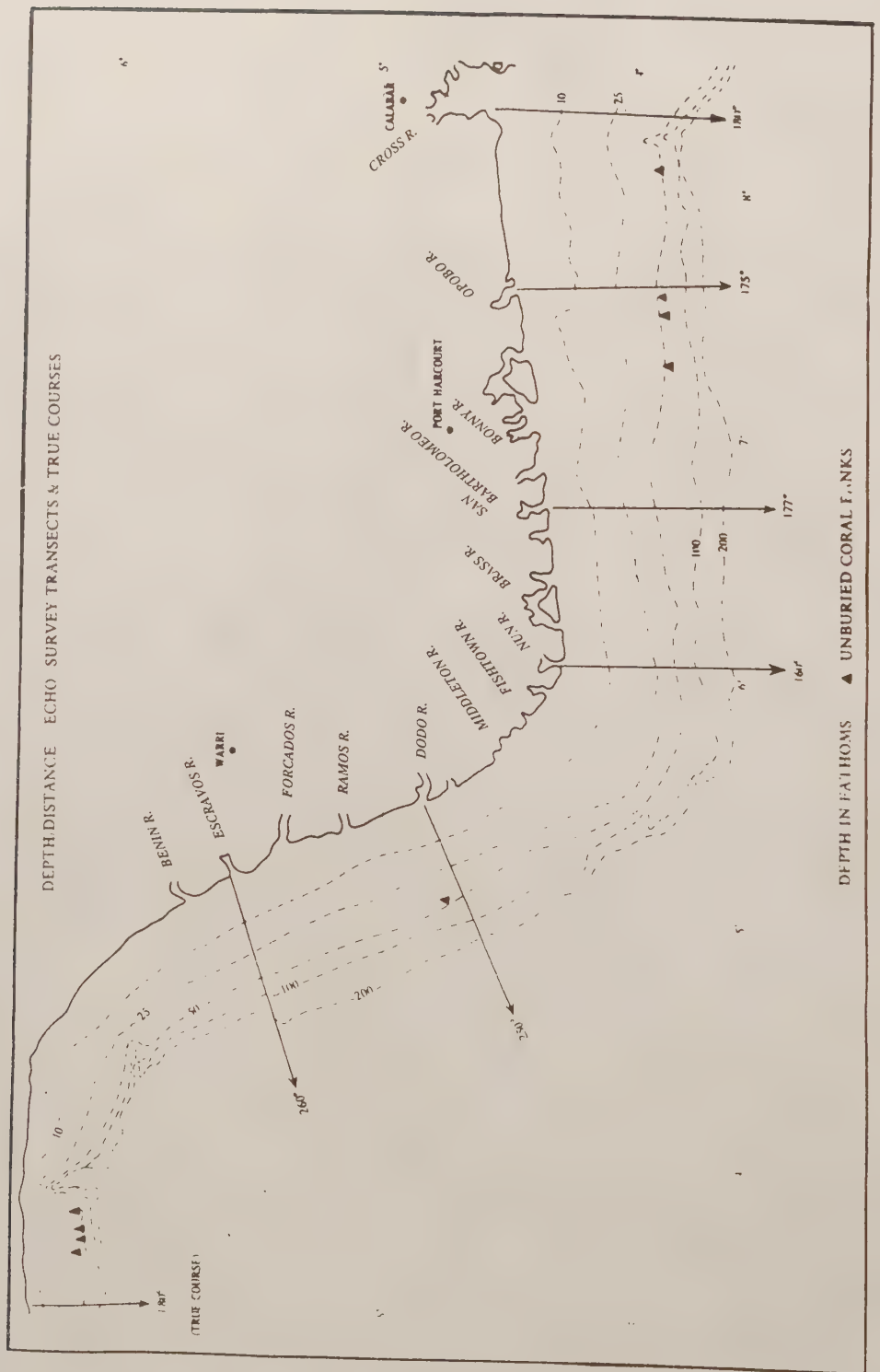



**Figure 2. The Nigerian Continental Shelf, with depth contours in fathoms, and unburied coral banks (based on sheet D200/375/7-74 by Federal Surveys Nigeria 1974)**

Some of the other coastal characteristics which are of importance to the Nigerian inshore demersal fisheries are the presence of thirty-six estuaries (Amadi, 1990) and the prominent Niger delta, which provides suitable habitat for the penaeid shrimps, finfish and other living marine resources. Hydrographically, the temperatures are generally above 25°C down to 50-m depth and there exists a permanent thermocline, which acts as a natural barrier to the vertical distribution of fish down to 30-40 m with a lower limit of 50-60 m. Salinities range in the area off Lagos from 34‰ from the surface to 50 m depth to about 30‰ off the S. Eastern coast extended down to 30 m where freshwater run off influence the shelf water. The oxygen content is rich steadily decreasing with depth down to 400 m (Amadi, 1982).

## 2. THE INSHORE MARINE FISHERIES

### 2.1 Resources: Exploratory resource surveys/potential yields

Various efforts have been made in the past four decades by the Nigerian Institute of Oceanography and Marine Research (NIOMR) and others to survey the marine resources and estimate the potential yields for the inshore marine fish and shrimp resources. The exploratory Guinea Trawling survey conducted during 1963 and 1964 between 15-50 m depth evaluated the biomass of the central portion of the Nigerian continental shelf and the entire shelf area as 21 100 MT and 351 000 MT respectively (Williams, 19968). Based on experimental trawls during the 1962-1963 inshore resource survey, Longhurst (1969) predicted that the potential yield of sciaenid community was 11 000 MT, which could increase to 141 500 MT when the sub-thermocline sparid community was included. Longhurst (1969) reported that: *Penaeus notialis* (*duorarum*) and *Parapenaeopsis atlantica* occur abundantly off the Niger delta between 27-45 m and 9-27 m depths respectively.

Raitt and Niven (1965 – 1969) confirmed the potential and identified four areas of exceptionally high catch rates with off-peak catch rates of 24-51 kg/hr head-on which were higher than the break- even value of 19 kg/hr head-on recorded by Bayagbona *et al*, in 1971. Even though shrimping could be undertaken all year round, June and December featured the highest catch rates. FAO (1969) carried out surveys in the Western and Mid-Western regions, which concentrated on *Penaeus notialis* and estimated potential yield of 2 500 MT. Some attention was paid to the clupeids too. Bayagbona (1979) analysed 1971-1978 catch and effort data and estimated the MSY of *P. notialis* and *Parapenaeopsis atlantica* as 245 MT and 904 MT respectively. By 1973, the annual potential of penaeid shrimps was estimated to be between 3 500 and 4 000 tonnes (Ajayi, 1991).

With the acquisition of more vessels of higher research capacities for marine fish resources survey, NIOMR was able to intensify the implementation of the fisheries resources programme and consequently Tobor (1991) reported the estimated yield potentials of inshore waters 0-50 m. Offshore demersal and pelagic resources are reported to be 16 620 MT, 6 730 MT and 9 460 MT respectively. Deeper water surveys have also indicated some fisheries resources, which have economic potentials. These include: Tunas, whose potential yield was estimated in 1982 and 1983 at about 10 000 per annum and driftfishes, *Arioma bondi*, *A melanum* with catch rates of 63-160 kg/hr between 140-250 m depth off the mouths of Benin, Escravos, Forcados and Sambreiro Rivers, deeper water shrimps – *Plesipenaeus edwardsianus* and lobsters – *Neobarriotta pinnata* (40 m – 600 m depth). A major obstacle to the tuna exploitation was the lack of tuna baitfish. NIOMR has carried out a survey in which anchovy was found but commercial investment in the fishery is yet to commence. R/V DR. Fridtjof Nansen trawling survey of 1981 confirmed the occurrence of sparids between 50 m – 200-m depth. The catch rates in kg/hr of the important species in the surveyed area included:

| Species | kg/h |
|---|---|
| *Priacanthus arentus* | 21.9 |
| *Arioma bondi* | 6.8 |
| *Dentex angiolensis* | 6.3 |
| *D. Congolensis* | 5.1 |
| *Spicara alta* | 4.1 |
| *Trichiurus lepturus* | 2.8 |
| *Brachydeuterus auritus* | 1.7 |
| *Squatina aulata* | 1.9 |
| *Epinephelus aeneus* | 2.0 |
| Shrimp | 5.3 |
| Cephalopods | 1.9 |

(Amadi, 1982)

## 2.2 General description of the fisheries

**The industrial inshore fisheries sub-sector.** The Nigerian industrial inshore fishing activities consist of trawling for demersal finfish and shellfish, principally penaeid shrimps. The finfish species are heterogeneous and occur down to 50-m depth. They belong to supra-thermocline and sub-thermocline communities. Tobor (1965–1968) recorded 71 families comprising 157 species most of which are small in size. But the major target families/species of the supra-thermocline community (i.e. sciaenids) include:

- *Sciaenidae,* (croakers), *Pseudotolithus typus, P. senegensis, P. elongatus* and *P. brachynathus* (4 species).

- *Cynoglossidae* (Tongue Sole), *Cynoglossus senegalensis, C. Canariensis, C. mondi* and *C. browni.*

- *Ariidae* (Catfish), *Arius heudeloti, A. gigas, A.Latiscutatus, A. parki.*

- *Polynemidae* (Shrinynose or Threadfins), *Polydactylus quadrifilis, Galeoides decadactylus.*

- *Haemulidae* (Grunters); *Pomadasys jubelini, P. suillus; P. incisus, P. peroteti.*

- *Sphyraenidae* (barracudas), *Sphyraena barracuda, S. afra, S. guachancho.*

- *Carangidae* (Jack fish), *Caranx hippos, C. crysos, C. latus, C. lugubris.*

Other sciaenids, which occur in Nigeria waters, include the bigeye grunt (*Brachydeuterus auritus*) and moonfish, (*Vomer setapinnis*). Some of these fish species are also genetically undersized including the members of the prominent pelagic family Clupeidae such as *Sardinella* spp. which are fished intensively by the artisanal sector. The sparid community comprises mainly the following major families/species: - Lutjanidae (Red snappers) – *Lutjanus goreensis L. fulgens, L. agennes* and *L. dentatus*, and serranidae (Groupers), *Epinephelus aeneus*. Other sparid family/species found in Nigerian waters are the Sparidae, *Dentex canariaensis, D. angolensis, D. congoensis* (down to 50 m depth and below), and the breams e.g. *Pagrus* Sp. *Pagellus coupei* and *Pagus* sp. down to 170-m depth and below. The commercial penaeid shrimps being exploited in the Nigerian coastal waters predominantly inhabit the soft mud substrate of the Niger Delta and eastwards to Cross River. They occur too in Lagos West Grounds. Their order of importance in the inshore shrimp fishery of Nigeria is:

- *Panaeus notialis* (White prawn) down 27 m to 45 m)

- *Parapenaeopsis atlantica* (Brown (or Guinea) shrimp) down 9 m – 27 m)

- *Parapenaus longirostris* (Rose or Red deep water shrimp) down 150 m – 200 m)

- *Penaeus krathurus* (Striped or tiger shrimp).

- *Palaemonidae, Nematopalaemon hastatus* (Estuarine prawn) also occur in the Nigeria waters but are mostly exploited by the small-scale fishermen.

The artisanal coastal fisheries. The artisanal marine fisheries can be categorised into:

- Brackish water or estuarine canoe fishery operating in lagoons, creeks and estuarines.
- The coastal canoe fishery operates usually within the 5 nm non-trawling zone but due to motorization and targeted stocks some of the operators may venture farther into the sea. They lose a lot of fishing days to inclement weather and scarcity of production inputs etc.
- The artisanal group which mainly targets sharks and operates deep into the sea, deploying drift nets for sharks, sail fishes and saw fishes.

The small-scale fishermen operate dug-out or improved canoes and they are 2 to 10 men on board according to the type of fishery engaged in. Most fish caught belongs to the sciaenid community including croakers and bonga, shad, catfish, sardines, soles, shinynose, etc. *Polydaclylus spp.* (Polynemidae) as well as members of the Sphraenidae, Lutjanidae, Elopidae, Serranidae, and Carangidae families. The small-scale fishermen also catch sharks, sail/saw fishes as well as penaeid, palaemonid, and carid shrimps. They exploit mostly the same with motorized fishing vessels known locally as "Motor Fishing Vessels" which are licensed to trawl for fish.

FAO (1969) conducted a comprehensive survey of the coastal and estuarine fisheries of Western Nigeria fisheries covering about 6 400 km. Of the 91 203 fishermen estimated, 54.32% were full time. Sentongo, *et al.*, (1983) put the coastal fishermen population at about 149 000. Between 1990 and 1997 the coastal artisanal fisheries structure and production were (Table 3 below):

**TABLE 3: Coastal artisanal fisheries structure and production between 1990 and 1997**

| Year | No of canoes | % motorised | Part-time | Full-time | Total Nos. | Fish Production (MT) |
|---|---|---|---|---|---|---|
| 1990 | 76,891 | 20.38 | 190,900 | 261,287 | 452,187 | 170,459 |
| 1991 | 77,093 | 20.79 | 190,958 | 264,144 | 457,102 | 681,211 |
| 1992 | 77,076 | 20.81 | 194,016 | 265,831 | 459,847 | 841,407 |
| 1993 | 77,050 | 20.82 | 192,624 | 263,757 | 456,381 | 106,276 |
| 1994 | 77,073 | 20.8 | 193,198 | 264,577 | 457,775 | 124,117 |
| 1995 | 77,067 | 20.81 | 263,919 | 192,739 | 456,658 | 159,201 |
| 1996 | 77,071 | 20.80 | 264,446 | 193,107 | 457,553 | 138,274 |
| 1997 | 77,036 | 20.83 | 264,506 | 133,134 | 397,640 | 152,212 |

Source: FD Fisheries

The Table above makes the catch per fisherman amounting between 1990 – 1997 to 0.378 MT, 0.367 MT, 0.40 MT, 0.23 MT, 0.27 MT, 0.349 MT, 0.303 MT and 0.383 MT respectively. Scott (1966) showed an average catch per fisherman in the coastal and brackish waters of the Niger delta to be 0.60 MT per annum. A baseline survey conducted under the IFAD project in 1992-1993 showed a mean landing of 25.92 MT year for a gauge fishing unit (GFU) in the South-eastern states of Rivers, Akwa Ibom and Cross River (Moses, 1994). The fish production levels attained between 1976 and 1984 are attributable to the fisheries policy of Government in that period which featured assistance to artisanal fishermen under packaged programmes.

**Socio–Economic status of artisanal sector.** The artisanal fishermen live in temporary or permanent fishing settlements along the creeks, lagoons and beaches throughout the coastline of the country. Majority of settlements is relatively little known but some seem comparatively prosperous in certain very productive areas of Lagos, Ogun, Ondo, Delta, Bayelsa, Rivers, Akwa Ibom and Cross River States. The population of the settlements could range from as low as 50 to areas as high as 10 000. The result of a comprehensive study carried out in 1982 showed that over 50% of the population in the coastal states are within 20-40 years age bracket. The general features of most of these rural fishing settlements are difficulty of access, lack of or inadequate functional social infrastructure such as landing jetties, cold storage facilities, schools, medical or health facilities, water and electricity supplies, etc. Majority of the household members engage in fishing while others are traders, students, artisans, public service or private employees. Some of the household members are unemployed. The standard of living is generally low relative to the other non-fishing communities and reflect an abject poverty not befitting a virile population that produced about 32.5%, 39.4%, 46 %, 50.3%, 40.7% and 40.5% of Nigerian fish supply by all sectors (including fish importation) from 1992 to 1997 (source: Fed. Dept. of Fisheries). The capital formation shows stock components valued at between N 62 000.00 and N 310 000 per GFU (Moses, 1994). These include boats, outboard engine and fishing gear in very active fishing areas. These fishing inputs are either modern in terms of fibre-glass boats of 6-18 m LOA, outboard motors (8HP-40HP) and synthetic nets or could be obsolete non-motorised dug-out canoes with paddles, hooks and lines, etc. In the coastal areas, fishing activities take place on daily basis but are strongly subjected to the vagaries of the weather and season. Productivity relates to the intensity of fishing activities, proximity of fishing grounds and ready availability of suitable fishing, inputs. The significant decline in fishing production by the artisanal sector (coastal and brackish water) from 246 784 in 1984 to 138 274 in 1996 and 1997 was attributed largely to inhibitive cost of fishing inputs, and scarcity as well as sharp upward adjustment of prices of petroleum products, etc. in the Post-SAP era. There has been Government intervention in the area of poverty alleviation and through the implementation of local and internationally supported artisanal fisheries development programmes. Efforts have been made to disburse loans to small-scale fishermen for a procurement of fishing input under the International Fund for Agricultural Development (IFAD) and economic Community of West African States (ECOWAS) assistance programme. However, both assistance schemes cover only a negligible proportion of the artisanal fishermen in four coastal and seven inland states to the tune of N 40.5 millions and N 13 millions respectively (Source: C.B.N. Report, 1994. Actual exchange rate:

US$1 = ~90 N). The future prospects for artisanal marine fisheries development are bright because of the priority attention being accorded to Agriculture, including the fisheries sector under the present civilian Administration.

**Fisheries share in the Gross Domestic Product (GDP).** The aggregate output of the Nigerian economy measured by the GDP at 1984 factor cost grew by 2.4% compared with the increase of 3.2% and 3.4%. In 1996 and 1997, the slight growth in aggregate output is attributed to the resilience of the agricultural sector, among other factors, and the lower growth in production compared with 1996 and 1997 is attributed to high costs of production inputs, persistent shortages of fuel, etc. The share of agricultural production comprising Crops, Livestock, Forestry and Fishing amounted to N 45.61 billion or 40.4% of GDP compared with the respective ratio of 39.4% and 39.0% in 1996 and 1997. At 105.7 (1984 = 100), the index of fish production rose by 6.2% compared with 11.3% in 1997. Fishing contributed N 1.2b, N 1.23b, N 1.48b, N 1.65b, and N 1.88b respectively to the GDP in 1994, 1995, 1996, 1997 and 1998, placing it third among the four sub-sectors of Agriculture since 1996 ahead of Forestry. Many inhibiting factors contributed to the reduction in the rate of growth of fish production. These include the acute shortage and escalation in the costs of vital fish production inputs such as diesel oil (AGO) which hindered shrimp and fish exploitation efforts. In addition, the communal clashes in the Niger delta and the high incidence of sea piracy compounded the problem of the sub-sector by reducing access to fishing grounds. Table 4 below shows the share of the Agricultural sector in the GDP for 1998:

**TABLE 4: The share of the agricultural sector in the gross domestic product at 1984 Factor cost**

| | N (billion) | | | | |
|---|---|---|---|---|---|
| **Activity Sector** | **1994** | **1995** | **1996** | **1997** | **1998** |
| 1 Agriculture (crop production) | 31.04 | 32.09 | 33.31 | 34.74 | 36.46 |
| 2 Livestock | 5.22 | 5.44 | 5.60 | 5.74 | 5.89 |
| 3 Forestry | 1.32 | 1.35 | 1.36 | 1.37 | 1.38 |
| 4 Fishing | 1.12 | 1.23 | 1.48 | 1.65 | 1.88 |

Source: Central Bank of Nigeria Annual Report (1998)

### 2.3 Vessel characteristics, gear and accessories; fishing methods and practices; fishing effort

Vessel, gear and accessories characteristics

The Sea Fisheries (Licensing) Regulations of 1992 provide that a Shrimping vessel shall not exceed 23.2 m LOA and 130 GRT, while a Fishing vessel shall not exceed 25.3 m LOA and 150 GRT.

The typical specifications of a shrimp trawler are:

| | |
|---|---|
| Length over All (LOA) | - 23.20 m – 24.62 m |
| Breadth | - 5.8 – 7.5 m |
| Depth Moulded | - 3.4 – 4.2 m |
| Draft | - 2.9 – 4.5 m |
| Cruising speed | - At least 10 knots/hr |
| Towing speed | - 2.5 – 3.0 knots/hr |
| Average Engine Power | - Main 450 HP – 800 HP; Auxiliary 80 HP |
| Fish finding equipment | - Echo-sounder of vertical type |
| Navigational Aids | - Compass, Decca-navigator/Radios SSB UHF Satellite Navigators |
| Refrigerated fish hold | - About 60 tonnes at - 25°C |
| Fuel Tank | - 50 – 80 MT |
| Fresh Water Tank | - 15 Cubic Meters |
| Voyage days | - 25 – 45 |
| Plate Freezer Temperature/Capacity | - About 0.5 MT/hr at - 30°C – Freezing within 4 hours |
| Accommodation | - 11-13 crew member (Nigerian/Foreign) |
| Outriggers/Boom Vessel | - Galvanised steel material at fore part behind wheel house |

The figure 3 is a technical sketches of a shrimp trawler with outriggers showing the general arrangement of the vessel, the two shrimp trawls and a try net. It is worth mentioning that the motorized vessels operating in coastal areas locally known as "Motor Fishing Vessels" have been arranged and equiped to meet the international standard of shrimp production and processing facilities.

As far as the shrimp trawl are concerned, the netting material is either polythylene (PE) or polypropylene (PP) and meshsize in all trawl sections, apart in the codends, is between 51 mm and 55 mm. The twine diameter is around 1.4 - 1.6 mm in all sections except coden with 1.9 mm and more, of diamond mesh type. The legal codend meshsizes for the fish trawl net and shrimp trawl net are 76 mm and 44 mm stretched respectively. The technical sketche of a typical shrimp trawl net is given in figure 4.

The otter boards are not uniform in weight and dimension. Dimensions are: 2.00 – 4.00 m in length and 1.00 – 2.00 m in hight; the weight is 200 kg – 270 kg; the backstrops are about 4.5 m long made of steel wire ropes of 14 – 16 mm diameter with G-hooks; the pennants are usually 7.00 m long wire rope steel of 14 mm in diameter with G-hooks and recessed links. Shackles 21 – 22 mm are used.

Fishing Efforts/Practices/Crewing

According to the Nigerian Trawler Owners Association (NITOA) sources, about 36 fishing companies presently own 271 Nigerian flag–registered vessels, some of them having been built in USA and Poland. However, not all vessels are operational. Their ownership is either fully Nigerian or joint–ventureship between Nigerians and Foreigners. Government policy currently permits 100% foreign ownership.

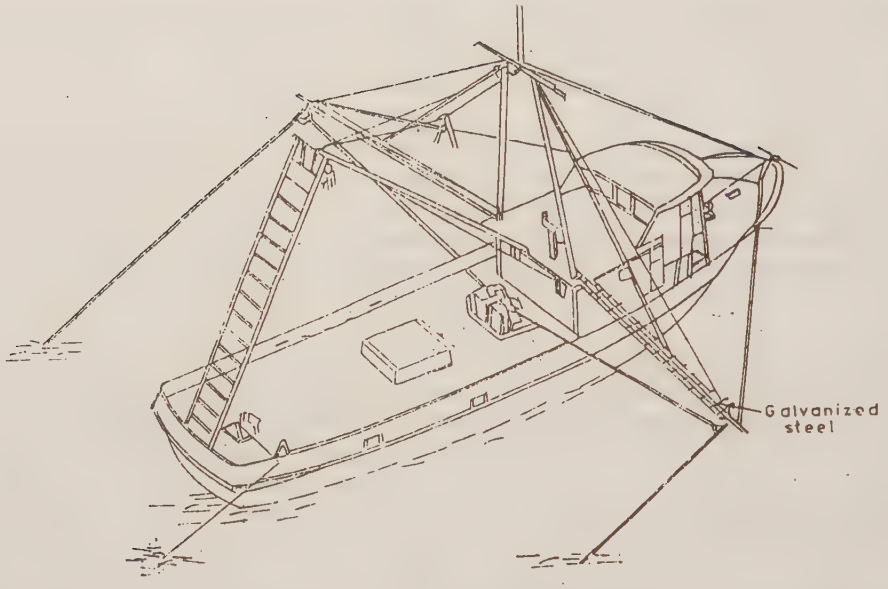
The double–rigged/outrigger refrigerated vessels operate day and night using their booms to pull either two or four otter shrimp trawl nets with tickler chains. Turtle Excluder Device (TED) regulation came into force in 1996 to protect the sea turtles. The towing speed is between 2.5–3.0 knots and trawling time is about 3 hours.

The vessels are crewed with about 3 000 foreign and Nigerian crew the later being mostly home – trained Mate certificate holders and 2$^{nd}$ class Engineers. The skippers and chief engineers are mostly Asian and Ghanaian nationals.

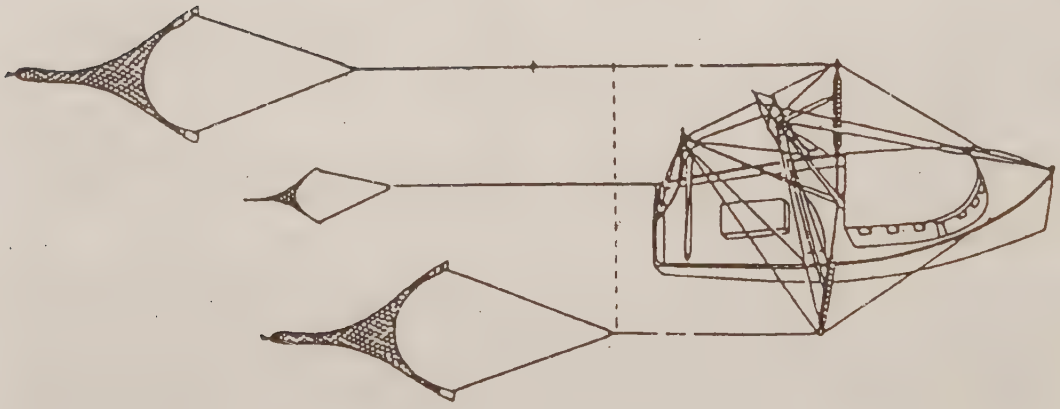
In 1999, 31 vessels were licensed to trawl for fish and 187 for shrimps, a considerable drop from the total of 306 vessels licensed in 1997 (266 of which were to trawl for shrimps). This drop is attributable to ageing, non-operational vessels, the withdrawal of most of the 13 m LOA medium-sized vessels from operation and the 1999 licence fee of N 120 000/year for each shrimp trawler above 20 GRT. The Licensing pattern showed a significant shift from fishing to shrimping in the post-SAP (Structural Adjustment Programme) era of 1986 when inshore shrimping vessels rose in number from 54 to 132 in 1988. The change was induced by the desire of investors to earn highly value foreign exchange through shrimp exportation; but this puts the shrimp resources under more severe pressure.

### 2.4 Shrimp catches, catch per unit effort (CPUE) and marketing

Early attempts at fishing in the inshore waters of Nigeria commenced in the mid 1950's. There had had at that time only some preliminary resources exploratory surveys and inadequate stock assessment studies which could have ensured the sustainability of the trawl fisheries. The knowledge of fishing ground, appropriate craft and gear was also scanty. By 1960, there was some improvement and first intensive fishing commenced on the Lagos West grounds (i.e. Coition – Elk) with the use of bottom trawls with 40 mm meshsize in the codend (Longhurst;1961). However, by 1964 there were indications of over fishing. Bayagbona (1965) analysed 1959–1963 catches of the Lagos based fleet and estimated the maximum sustainable yield of 1 036 MT on estimated annual effort of 90 x 10 horsepower hours. But Longhurst (1964) recorded the actual annual landing of the fleet to be 3,500 MT. The eventual collapse of the fisheries of the area led to decide the closure of the fishing grounds (Sea Fisheries Decree No 30 of 1971). It is pertinent to note that after over two decades of non-trawling on these grounds, the national research institution, NIOMR, pointed out the recovery of the marine fisheries resources in the area. The Sea Fisheries Decree No 71 of 1992 now permits fishing under licence in the Lagos West grounds.




**Typical double otter trawling**



**Otter twin trawl**

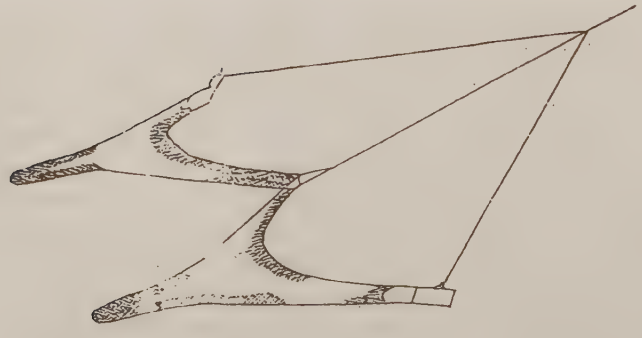


**Figure 3. Shrimp trawñer with outriggers**

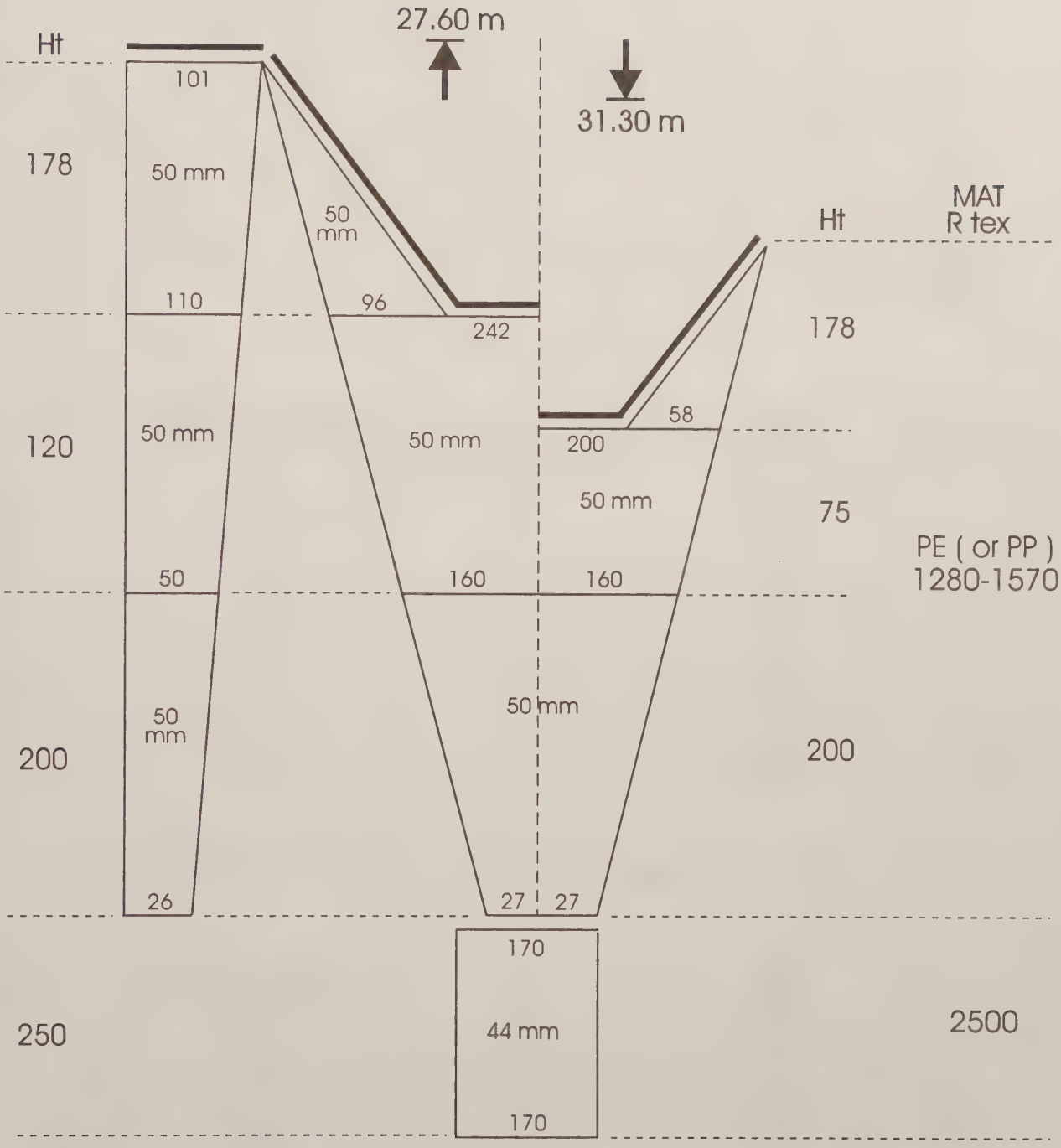



**Figure 4. Nigerian shrimp trawl net**

Trawling for shrimps assumed greater importance in the immediate post-SAP era of the mid 1980's. The most prominent penaeid shrimp target was *Penaeus notialis* commonly referred to as white prawn in Nigeria. Other peaneid targets are *Parapenaeosis atlantica* (brown shrimp); *Parapenaeus longirostris* (Deeper water Rose or Red shrimp); *Penaeus kerathurus* (striped or tiger shrimp).

Tables 5 and 6 show the catch statistics for shrimps and fish between 1985 and 1997 (source: FDF). Initially, the quality of landed shrimps in terms of size used to be very high. The white prawns used to be graded 0-8 with zero being the jumbo size and most expensive while 8 size was the least in value. Grades 5-7 constitute the bulk of the white prawn catch presently. The brown shrimp is assuming greater proportion of landings particularly in the dry season, while the other penaeid shrimps are being intensively exploited, the deeper water shrimps, *P. longirostris* are yet to be commercially exploited. Sequel to the shift from trawling for fish to trawling for shrimps from 1986 onwards, the pressure on the penaeid shrimp fishery intensified. Thus, the annual catch of the shrimps was, between 1992 and 1997 more than 9,000 (up to more than 12,000 MT) despite the MSY estimated to be between 3 500 MT and 4 000 MT. The total shrimp export to Europe in 1998 was 8 300 MT. This calls for the continuous assessment of the yield potential of panaeid shrimp stocks using more accurate catch and effort data, more so, when the indications are that the Nigerian trawl shrimp industrialists still appear to be favourably disposed to further investment in the shrimp trawling business.

**TABLE 5. Shrimp production – from 1985 to 1997**

| YEAR | **Quantity** (Metric Tonnes) |
|---|---|
| 1985 | 2,376 |
| 1986 | 2,623 |
| 1987 | 3,517 |
| 1988 | 2,868 |
| 1989 | 5,234 |
| 1990 | 3,666 |
| 1991 | 6,200 |
| 1992 | 9,373 |
| 1993 | 8,956 |
| 1994 | 7,884 |
| 1995 | 12,252 |
| 1996 | 9,551 |
| 1997 | 10,807 |

**TABLE 6. Catch from Inshore fishing and shrimping – from 1985 to 1997**

| YEAR | **Quantity** (Metric Tonnes) |
|---|---|
| 1985 | 26,142 |
| 1986 | 25,042 |
| 1987 | 24,900 |
| 1988 | 35,645 |
| 1989 | 33,645 |
| 1990 | 24,786 |
| 1991 | 34,968 |
| 1992 | 34,965 |
| 1993 | 31,420 |
| 1994 | 29,770 |
| 1995 | 33,479 |
| 1996 | 27,244 |
| 1997 | 27,703 |

The present data shows that the annual shrimp catch per vessel has not been stable and that between mid-1980's and 1990 there was a sharp drop in the catch per unit effort – See table 7. However there has been an observed increase from 1991 which appears to be levelling out.

**TABLE 7. Catch per unit effort (CPUE) of licenced shrimpers between 1985 and 1997**

| YEAR | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|
| TOTAL CATCH (MT) | 2 376 | 2 623 | 3 517 | 2 868 | 5 234 | 3 666 |
| No. OF SHRIMPERS | 40 | 54 | 82 | 132 | 158 | 195 |
| CPU (MT) CATCH/VESSEL | 59.4 | 48.57 | 42.80 | 21.72 | 33.72 | 18.80 |

| YEAR | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|
| TOTAL CATCH (MT) | 6 200 | 9 373 | 8 956 | 78 884 | 12 252 | 9 551 | 10 807 |
| No. OF SHRIMPERS | 195 | 203 | 223 | 230 | 235 | 196 | 266 |
| CPU (MT) CATCH/VESSEL | 31.70 | 46.10 | 40.16 | 40.16 | 34.27 | 48.73 | 40.63 |

Source: After Olaniyi, 1999

The deduction from this CPUE must be taken cautiously because of the level of reliability of the data bases, the unknown actual number of actively shrimping vessels and tile fact that even though some vessels were licensed to trawl for shrimps in the period under focus, their usage of trawl nets with under 44 mm stretched cod-ends would imply that they were engaged in trawling for shrimp not fish. Therefore, there should be no hasty conclusion about the situation of the Nigeria's inshore shrimp fishery. Quite recently but between December and March some surveys were undertaken at some popular fishing grounds at 0-50 m. Data gathered during the research exercise (sometimes at depths above the regulated 18-m depth) using a commercial vessel was analysed and catch in Kilogramme per hour of trawling (kg/hr) used in calculating the catch per unit effort (CPUE). It varies from one fishing ground to the other depending on the season, during movement of the target species, nature of the bottom sediment, abundance resources and other environmental factors. The CPUE calculated at various depths for some popular fishing grounds along the entire continental shelf between 16-22 m depth is shown in table 8 and 9.

**TABLE 8. Catch per unit effort at 10-14 metres depth on various fishing grounds**

| Fishing grounds | Depth (M) | CPUE (kg) |
|---|---|---|
| Lagos | 10 | 574 |
| Lagos Entrance | 14 | 279.2 |
| Ibeju | 10 | 274.6 |
| Lekki | 10 | 458.6 |
| Escravos | 13 | 557.4 |
| Sengana | 13 | 579.3 |
| Opobo | 10 | 312 |
| Kwa Iboe | 10 | 117 |
| Calabar | 10 | 277 |

**TABLE 9. Catch per unit effort at 16-20 metres depth on various fishing grounds**

| FISHING GROUND | DEPTH (M) | CPUE(kg)/hr |
|---|---|---|
| Lagos | 22 | 748 |
| Ibeju | 20 | 733.4 |
| Ajumo | 16 | 583.6 |
| Aiyetoro | 20 | 1352,2 |
| Escravos | 20 | 260 |
| Pennington | 22 | 342 |
| Dodo | 21 | 203.2 |
| Fishtown | 18 | 345.3 |
| Sengana | 16 | 254.7 |
| Nicholas | 20 | 378 |
| Nun | 16 | 242.1 |
| Brass | 18 | 780.2 |
| Bonny | 20 | 588 |
| Andoni | 18 | 136.4 |
| Opobo | 20 | 218 |
| Kwa Iboe | 20 | 132 |
| Calabar | 10 | 364 |

*Source:* Isebor, 1999

It is observable that grades 0-4 of white prawns, *Penaeus notialis* that fetch higher prices in the export market have become scarce in shrimp landings. A factor, which perhaps dictates the target of the domestics trawl shrimp fishery, is the current demand of the foreign market and the location of the domestic producer's buyer. A decade back when American and Japanese markets were more patronised, the targets were mainly *P. notialis* which were then semi-processed. Presently, products are mostly exported freshly deep-frozen, head-on, whole or headless, peeled-undeveined (PUD) and decapitated. The main focus is presently on brown shrimps caught in shallower waters with the implication of greater encounter of shrimp trawlers on grounds where small-sized fish species are more abundant. Hence, as a whole, the impact of shrimp trawling fisheries on juvenile fish and other benthic communities is now greater.

## 2.5 By-catch and discards/utilisation

Past and present studies confirm the importance of fish bycatches, their species/size composition, discards and mode of utilisation of the bycatch which kept on board when trawling for penaid shrimps in the Nigerian waters which have a multi-species fisheries regime. The occurrence of small but mature fish species in the penaid trawling grounds makes a selection within the fishing gear rather difficult. Even though, trawling for shrimps within the first five nautical miles of the Nigerian continental shelf and in waters shallower than 18 m are prohibited and the codend of a shrimp trawl should have more than 44 mm meshsize, yet observations of fish landings and activities at sea suggest that these statutory provisions of the fishing regulations are not being strictly complied with.

On board vessels, after the trawl net is hauled, its codend is opened and washing/sorting/grading of products into various categories are quickly undertaken. The sorted fish are sealed in 20-kg bags and placed in the refrigerated fish hold at about - 25°C. Similarly the shrimps are packaged in 2.2 kg packets and quickly frozen in batches in the plate freezers on the deck at - 30°C within 4 hours before being stowed in the fish hold in master cartons. Those earmarked for peeling are bagged. The fish by-catch of target species and incidental catches of non-target species is found to be of considerable quantity: 60 to 90 kg per day were reported. The by-catch problem has been immensely compounded by the concentration of the shrimp trawl industry presently on brown shrimps (Caricari) at grounds, which would appear to be the nursery ground of young and juvenile fish. It is common to see several canoes going after fishing trawlers for the sake of discards.

Ajayi and Adetayo (1982) carried out several exploratory trawl hauls between November 1980 and March 1981 working alongside commercial boats in the Niger delta area. They analysed the species composition of the catch and other data, contrasted these with the catch and effort data gathered by FDF since 1970 from the industrial fishing fleet and determined the species composition of the fish discarded as indicated in Table 11.

Visits to coastal fishing villages and general interaction with small-scale fishermen confirm that fishing inputs are very expensive and beyond the revenues of fishermen. Otobotokere (1999) recently reported evidence of sale of discards estimated at about 3 MT daily. The species and size ranges of sampled fish by-catch sold into riverine local markets are shown in Table 11. The average adult length and size at maturity of these fishes indicate that a fairly large quantity of them are removed before reaching maturity and this is bound to have adverse consequences on recruitment. Also there are indications from the Gulf of Guinea Large Marine Ecosystem survey carried out between February and March (1999) of a severe impact of shrimp trawling fisheries on the juvenile of commercial finfish resources. About 90% of the fish by-catch were said to be juvenile and small sized fish. The results of a recent study of the fish by-catch problem at various depths of some popular fishing grounds in Nigeria confirm again that there are high percentages of by-catches accompanying penaeid shrimping in Nigeria. The catch composition varies from one fishing ground to another depending on the targeted species. See Tables 12 and 13, which indicate species and percentage composition on various fishing grounds. Akande (1997) also reported the ratio of shrimp to by-catch based on the catch data of commercial vessels between 1992 and 1997. See Tables 14 and 15. Some naturally small sized fish species were observed to constitute more than 70% of catch at some grounds. Furthermore, an attempt has been made to quantify the juvenile or slow growing fish by-catch through interviews held with some crew members: 10-15 bags of 6 kg juvenile fish are said to be caught daily when targeting brown shrimps and 5-7 bags of 6 kg when targeting white prawns. The commercial value of this trash fish is not high but it contributes to the domestic fish market as food fish and raw materials for the fast food industry. Notwithstanding the lower commercial value of non-target small sized fish species, the large quantity of juvenile of commercial species is a serious concern for biological diversity and sustainability of the shrimp trawling fisheries. The estimate based on the assumption of three and four trips per annum for white prawns and brown shrimps respectively is that about 3 000 MT/year of trash, juvenile and non-commercial fish species may be caught annually by 200 actively operating vessels (Olaniyi, 1999).

Apart from finfish, non-fish species are also caught as by-catch: crabs – *Portunus validus* (Smooth swim crab. at around 30 m depth) and lobsters – *Panulirus regius* (5 – 40 m depth);brown Cuttle fish – *Sepia officianalis* (down to 200 m) and octopus; turtle – *Eretmochelys imbricate* (Hawksbill), *Lepidochelys olivacea* (Olive-ridley); molluscs e.g. snails and bivalves;

**TABLE 10. The major groups and component species of incidental fish catch, 1970-1980**

| Fish Group | Mean Composition of Commercial Landing | Component Species |
|---|---|---|
| Sciaenidae | 16.83% | Pseudotolithus typus<br>P. senegalensis<br>P. elongatus |
| Cynoglossidae | 9.32% | Cynoglossus canariensis<br>C. senegalensis<br>C. monodi |
| Ariidae | | Arius heudeloti<br>A. latisculatus |
| Polynemidae | | Pentanemus quinquarius<br>Galeoides decadactylus<br>Polydactylus quadrfilis |
| Pomadasydae | 41.13% | Pomadasys jubelini<br>P. suillus |
| Selachians | | Raja miraletus<br>Dasyastis margarita<br>Carcharias taurus |
| Mixed | | Brachydeuterus auritus<br>Illisha africana<br>Vomer setapinis<br>Drepane africana<br>Trichiurus lepturus<br>Larimus peli<br>Gerres melanopterus |

*Source*: Adetayo and Ajayi, 1982

**TABLE 11. Size ranges of fish sampled from discards sold at sea by shrimp trawlers in Niger delta waters**

| Family | Species | No. | Size Range (cm) |
|---|---|---|---|
| Carangidae | Hemicaranz bicolor | 7 | 8-14 |
| | Selene dorsalis | 17 | 5-7 |
| Cynoglossidae | Cynoglossus senegalensis | 81 | 10-23 |
| Drephanidae | Drepane africana | 92 | 4-11 |
| Ephippidae | Chaetodipterus spp | 1 | 6-12 |
| Haemulidae | Pomadasys jubelini | 26 | 9-14 |
| | Galeoides decadactylus | 27 | 10-16 |
| Pristigateridae | Polydactylus quadrifilis | 76 | 10-15 |
| Sciaenidae | Illisha africana | 67 | 5-23 |
| | Pseudolithus elongatus | 10 | 11-15 |
| | P. senegalensis | 183 | 7-18 |
| Sparidae | P. typus | 183 | 12-16 |
| | Pegallus bellotii | 2 | 11-14 |
| | Pegallus spp | 40 | 6-13 |

*Source*: Otobotekere, 1999

**TABLE 12. Percentage composition of shrimping operation at 10-14 metres depth on various fishing grounds**

| Fishing Ground | Depth (m) | Fish % | Shrimp % | Crab % | By-Catch % |
|---|---|---|---|---|---|
| Lagos | 10 | 50.7 | 4.7 | 0 | 41.6 |
| Lagos Entrance | 14 | 28.2 | 0 | 0.1 | 71.6 |
| Ibeju | 10 | 27.5 | 0 | 0.4 | 72.1 |
| Lekki | 10 | 55 | 0 | 0 | 45 |
| Escravos | 13 | 36 | 1.7 | 4.8 | 57.4 |
| Sengana | 13 | 43 | 4.8 | 1.2 | 51 |
| Opobo | 10 | 62.8 | 2.8 | 0 | 34.4 |
| Kwa Ibo | 10 | 25.7 | 24 | 0 | 50.3 |
| Calabar | 10 | 69.9 | 9.1 | 3.6 | 17.3 |

*Source:* Isebor

**TABLE 13. Percentage composition of shrimping operation at 16-20 metres depth on various fishing grounds**

| Fishing Ground | Depth (m) | Fish % | Shrimp % | Crab % | By-Catch % |
|---|---|---|---|---|---|
| Lagos | 22 | 47 | 0 | 0 | 52.9 |
| Ibeju | 20 | 40 | 12 | 0 | 48 |
| Ajumo | 16 | 40.1 | 2.7 | 0 | 57.1 |
| Aiyetoro | 20 | 22.2 | 3 | 0 | 74.8 |
| Escravos | 20 | 28 | 4.3 | 0 | 67.7 |
| Pennington | 22 | 17.8 | 3.5 | 3.8 | 74.9 |
| Dodo | 21 | 19.5 | 3.2 | 1.7 | 75.6 |
| Fishtown | 18 | 52.4 | 1.2 | 3.9 | 42.5 |
| Sengana | 16 | 50.6 | 1.2 | 3.6 | 44.6 |
| Nicholas | 20 | 64.8 | 0.8 | 4.8 | 29.6 |
| Nun | 10 | 61.5 | 12.1 | 4.5 | 18.9 |
| Brass | 18 | 45.2 | 1 | 2.8 | 51 |
| Bonny | 20 | 30.7 | 4.1 | 4.1 | 61 |
| Andoni | 18 | 10.3 | 1.7 | 0 | 88 |
| Opobo | 20 | 77.6 | 0 | 0.9 | 21 |
| Kwa Iboe | 20 | 70 | 9 | 0 | 21 |
| Calabar | 16 | 43 | 7.7 | 7.7 | 41.6 |

*Source:* Isebor

**TABLE 14. Catch analysis of a shrimper (kg), between 1992 and 1994**

| Month | Prawns | Shrimps | Totals | Fish bycatch | Shrimp to fish ratio |
|---|---|---|---|---|---|
| Nov./Dec.'92 | 3270 | 370 | 3646 | 5840 | 1:2 |
| Jan. '93 | 3900 | 544 | 4444 | 10200 | 1:2 |
| Feb./Mar'93 | 4126 | 990 | 5116 | 7500 | 1:2 |
| Mar/Apr'93 | 3556 | 240 | 3796 | 7300 | 1:2 |
| May '93 | 1956 | 636 | 2592 | 16420 | 1:6 |
| Jun/Jul'93 | 3168 | 674 | 3842 | 6560 | 1:2 |
| Jul/Aug'93 | 2274 | 2392 | 4666 | 19540 | 1:4 |
| Sep/Oct'93 | 2412 | 3954 | 6366 | 30600 | 1:5 |
| Oct/Nov'93 | 3272 | 5004 | 8276 | 20520 | 1:3 |
| Dec.'93 | 12 | 10718 | 10720 | 23600 | 1:2 |
| Jan.'94 | 326 | 5542 | 5868 | 10080 | 1:2 |
| Feb/Mar'94 | 448 | 13178 | 13626 | 14200 | 1:1 |
| Apr. '94 | 1048 | 10214 | 11262 | 22000 | 1:2 |
| May/Jun.'94 | 5528 | 4964 | 10492 | 14960 | 1:1 |
| July'94 | 2750 | 6756 | 9506 | 21520 | 1:2 |
| Aug/Sep.'94 | 456 | 11864 | 12320 | 17880 | 1:2 |
| Total | 38490 | 78048 | 116538 | 248720 | 1:2 |

*Source*: Akande, 1997

**TABLE 15. Catch data (kg) from shrimp trawlers (an average on six units) between January and December 1997**

| Species | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prawn/ shrimp (Penaeus notialis) | 32245 | 25745 | 46475 | 43542 | 47512 | 67225 | 34001 | 41608 | 35152 | 35764 | 35653 | 102647 |
| Croaker (Sciacnidae) | 10695 | 8329 | 6762 | 7299 | 6911 | 4691 | 6804 | 11515 | 10582 | 10339 | 11531 | 8879 |
| Sole (Cynogloss-dae) | 8929 | 6539 | 6408 | 7686 | 7446 | 9503 | 8759 | 14566 | 9765 | 13049 | 13150 | 5333 |
| Catfish (Arius sp.) | 20 | . | 20 | 16 | . | . | . | . | 486 | . | . | . |
| Ray(Raju sp.) | 590 | 169 | 707 | 494 | 350 | 411 | 240 | 570 | 529 | 594 | 719 | 700 |
| Grouper (Epinepbelus sp.) | 22 | . | . | . | . | . | . | . | . | . | . | . |
| Others | 39399 | 26622 | 33208 | 31419 | 35090 | 31598 | 27295 | 49661 | 45414 | 242152 | 53440 | 87561 |
| Total | 91900 | 67404 | 93580 | 90443 | 97329 | 113538 | 76009 | 117920 | 102928 | 301898 | 114491 | 205120 |
| Ratio of Shrimp to bycatch | 1:2 | 1:2 | 1:1 | 1:1 | 1:1 | 1:1 | 1:1 | 1:2 | 1:2 | 1.7 | 1:2 | 1:1 |

### 2.6 Marketing of Shrimps

The major markets for the Nigerian shrimp in Europe are Belgium, Portugal, Spain, France and the USA. The semi-processed white Prawns attract higher price (ranging according to sizes 1-7 from US$ 3 – US$ 18/kg) than the peeled, deveined and decapitated brown shrimps sold between US$ 2 and US$ 3. All are usually packaged in 2.2-kg packets into master cartons. The shrimp catches are ususally fairly clean, though they may contain a little bit of debris and mud/sand, which are easily washed on-board the vessel. Out of the 36 operational and active shrimping companies, 14 exported shrimps to Europe in 1998. The total export was 8 028.157 MT valued at 25 865 786.43 US$. Only one company exported processed shrimps, while the others sold them unprocessed. It is worthy to note that fishery products like cuttle fish and crab legs are gradually coming into the export trade though at a marginal level. Fish fillets especially soles (cynoglossidae) were also exported in 1998. Nigeria met the European Union quality standards and is therefore authorized to export shrimps to Europe. Since then, shrimp export has become better organised and it is safe to say that no product from Nigeria has been rejected in the international market as before the introduction of international standards. The Federal Department of Fisheries as the "Competent Authority" to certify shrimps for export has worked hard to ensure that shrimp and other fishery products meet the above mentioned standards.

## 3. REGULATIONS AND MANAGEMENT MEASURES

Nigeria's efforts to ensure responsible inshore fishing practices and proper management of the living marine fish and shell fish resources date back to 1971 when the first comprehensive marine fisheries legislation came into force under the Sea Fisheries Decree No 30 of 1971. In order to further promote the sustainability of the inshore fisheries and the fisheries of the Exclusive Economic Zone of Nigeria, the old decree was repealed in 1992 and replaced by the Sea Fisheries Decree No 71 of 1992. The main Decree contains the general provisions for the conditions for issue of "Motor Fishing Vessel Licences", duties and powers of Authorised Persons and penalties for offences committed under it. The supplements of the Decree namely "The Sea Fisheries (Fishing) Regulations" and the "Sea Fisheries (Licensing) Regulations" contain specific provisions which guide and control investment in industrial marine fishing business and mode of operating such a venture in Nigeria. The current sea fisheries licensing and fishing regulations which impact on shrimp trawling, its by-catch and discard are:

i) Obligatory pre-purchase assurance in writing by the licensing authority that any procured vessel entering into Nigerian shrimping business would be licensed after due process. This is a measure to control, before investment, fishing effort and for preventing over-capitalisation.

ii) Vessel survey and tonnage measurement in Nigeria by the Federal Ministry of Transport's Government Inspector of Shipping (GIS) to ensure that only suitable and permissible vessels enter into the Nigerian shrimping or fishing fleet.

iii) Restriction of size of a shrimp trawler to 23.2-m LOA and 130 GT to prevent over-sized vessels from entering into the trawl shrimp fishery.

iv) Delimitation of a 5 nm non-trawling zone which places restrictions on trawling in a sea water area covering about 7 898.78 km² of the Nigerian continental shelf essentially to protect the nursery ground from indiscriminate fishing. It is also to protect the artisanal fishermen who operate within the zone, as well as to reduce conflict between them and trawler operators.

v) Codend mesh size specification, 44 mm (1¾") stretched, for any shrimp trawl net to promote sustainability of inshore trawl fisheries through rational exploitation.

vi) Prohibition of the use of the same vessel licensed to trawl for fish from trawling for shrimps in order to limit the efforts to trawl for shrimps.

vii) Prohibition of dumping (i.e. discard) of edible and marketable sea products and transhipment at sea of by-catch. The immediate purpose is to encourage vessels, by bringing all catches back to the home port, to increase supply of fish to the domestic market; indirectly this should also discourage non-compliance with mesh size regulation which lead to catching small-sized or juvenile fish. By the side, when this provision is complied with by the industry, it will allow for easier study of the by-catch problem.

viii) Regulation concerning a minimum size of fish for sale to discourage the catching of under-sized fish and ensure the use of legal meshsize in the codend.

ix) Prohibition of single and pair trawling by motorized vessels less than 20 GT and in waters shallower than 18 m to protect the juvenile fish and biodiversity in fishing grounds which also happen to be the nursery grounds in some areas.

x) The installation of Turtle Excluder Device (TED) on shrimp trawl nets is a requirement from 19 September 1996.

The issue of closed areas and/or season is major concernfor the stakeholders in the Nigerian Shrimp trawling industry and the fisheries authority. Researches are being intensified in order that concrete decisions are based on scientific knowledges and evidence. There are periodic meetings among the members of Nigerian Trawler Owners Association, the Federal Deptment of Fisheries, the Nigeria Institute of Oceanography and Marine Research (NIOMR) and all other fisheries law enforcement agents i.e. the Nigerian Navy, The Marine Dept. of Nigeria Police, Nigerian Customs Service, surveyors or examiners appointed under the provisions of the Merchant Shipping Act. At these consultative fora, matters relating to legislation or any issue of interest to the inshore fishing industry, such as the management of the finite marine fisheries resources are exhaustively deliberated upon.

Constraints to better participation of stakeholders in the management of resources mainly relate to the fear of profit loss through perceived reduction in catches when gears with better selectivity are used. The lack of basic, essential, infrastructures on landing places or harbour to fulfil the needs of fishing operators and the generally not too conducive atmosphere may also constitute hindrances to a more co-operative attitude of the industry to the compliance with fishery management measures.

## 4. RESEARCH ACTIVITIES (PAST AND PRESENT)

i) The Nigerian Institute of Oceanography and Marine Research (NIOMR) undertook a lot of surveys in the past under the Marine Fisheries Resources programme. The research results provided the scientific basis for the promulgation of the repealed Sea Fisheries Decree No. 30 of 1971 under which for example fishing in the Lagos West grounds (i.e. The area of the continental shelf adjacent to the Lagos and the then Western States) was prohibited. Licensing as well as mesh size regulations were also introduced. The shrimp resource surveys and stock assessment led to the identification of the commercial potential of the penaeid shrimp resources particularly of the Niger Delta. As already mentioned, the annual potential of the shrimp resources was, in 1973, estimated to be between 3 500 MT and 4 000 MT. The maximum sustainable yield (MSY) was 2 008.02 MT in 1981. The annual catch rates and maximum yields of the penaeid shrimps – *P. notialis, Parapenaeopsis atlantica* and *Parapenaeus longirostris* were estimated byBayagbona (1979). Amadi (1982), Ajayi and Adetayo (1982) continued to investigate shrimp species abundance, distribution and catch rates. Scott (1996) highlighted the effect of shrimping on fish yield. Detailed research was conducted by Ajayi and Adetayo (1982) into the effect of shrimping trawling on biodiversity and first reported on the level of fish by-catch and discard of fishery. The overall conclusion was that the fish discard (measuring 18 cm or less) amounted to around 44% of the total catch prominently comprising *Brachydeuterus aurituslischa africana* and *Vomer setapinnis*. At the beginning of 1999, a short day survey was conducted in areas of Nigeria's coastal waters under the Gulf of Guinea Large Marine Ecosystem survey; preliminary results indicate a high proportion of under-sized fish species or juvenile to the tune of 70-90% in each haul, less than 15 cm in size.

ii) Another survey was carried out between December 1998 and March 1999 using a commercial shrimping vessel during the brown shrimp season. The by-catch was confirmed to comprise juvenile of commercially important species and other species whose maximum length at infinity does not exceed 35 cm; this group constituted more than 70% of the by-catch at some shrimping grounds (Isebor, 1999).

iii) It is obvious from the present situation that continuous monitoring of the fish and non-fish by-catch is very desirable. More research is required and funds for monitoring, control and surveillance projects aiming to more strict enforcement of the regulation should be looked for. more strictly.

Full knowledge of the behaviour of shrimp in the trawl nets is vital for their successful retention in the codends as shrimps have a tendency to be located near the bottom of the net as the water flow carries them to the codend (Mitchel *et al*, 1995). Some non-rigid devices such as shrimp/fish separator trawls, use of square meshes in place of diamond-shaped ones at the codends could be further researched. The

effectiveness of diamond-shaped 44 mm meshsize now in use for shrimp should be assessed and the consequences of an increase of this meshsize as mandatory should be documented.

## 5. IMPACT ON RESOURCES

### 5.1 Impact of present exploitation pattern on the shrimp resources

The present shrimp exploitation features the concentration of operations of about 200 vessels from Long 5° 00 'E to 8° 30 'E extending down to 80 m isobath at a distance of 7-26 nml from the coast. The most abundant species *P. notialis* is found between 10-50 m (Dublin-Green and Tobor, 1992). Shrimping voyages take 25-45 days. The intensity of shrimping, as earlier observed, have significantly increased in the past twelve years. Ajayi and Talabi (1984), stated that, based on a sustainable yield of 3500- 4000 MT of shrimp, the fishery in Nigeria cannot absorb more than 50-60 shrimp trawlers. However, since 1992, over 8 000 are reportedly landed every year. Certainly, the viability and profitability of the commercial shrimping venture particularly in the Niger Delta area and eastwards to Calabar river mouth and particularly the considerable foreign exchange earning capacity of shrimp products at export tend to make the investors thinking that the fishery can absorb more vessels. Caution must be taken, however, to avoid over-capitalisation and possible collapse of the shrimp fishery. Granted the level of reliability of available and published catch and effort statistics, the catches are now increasing but not steadily with the CPUE range of 31.71 MT, 46.1 MT, 40.16 MT and 34.27 MT between 1991 and 1994. In reality, with the use of codends with small meshes, the CPUE range would be 20.88 MT, 33.72 MT, 29.27 MT, 25.93 MT for the same period (Olaniyi, Otobotekere, 1999). With many trawlers scrambling in the same area, in coastal waters, to catch as much as they can, both growth and recruitment over fishing can occur (Pauly, 1980).

### 5.2. The impact of the present exploitation pattern on the fish resources

Vessels licensed to trawl for shrimps increased from 40 in 1985 to 230 in 1994 with corresponding increase in shrimp catch from 2 376 MT to 7 884 MT. A significant drop in the number of Motor Fishing Vessels licensed to trawl for fish occurred between 1988 and 1994 when 161 and 74 were permitted to fish respectively and, as a result, there was a drop in fish landings from this source. Species landed by shrimping vessels are similar to the landings of fish fishing vessels. The concern is in the sizes of the various fish species landed and the high percentage of the juvenile. The higher proportion of smaller-sized catch is due to the use in the codend of meshes less thanthe authorised 44-mm.

In addition, it is worth mentioning that, among the sciaenidae of tropical West Africa, those from the Niger-delta were found being smaller-sized than elsewhere (Longhurst (1964). This further explains the large quantity of small fish in the landings of shrimping vessels. The overall critical impact of the present exploitation results from the fact that the target penaeid shrimps are found in relatively shallow depths where vessels catch increased quantity of juvenile and genetically undersized fish. This impact could be minimised by:

(a) The strict enforcement of the codend mesh size of 44 mm;

(b) 5 nml non-trawling zone regulations to protect the vulnerable nursery grounds and small-sized fish species;

(c) The introduction of devices which allow easy escapement of juvenile or undersized fish.

### 5.3 The impact of the present shrimping practices on non-fish by-catch and on the bottom habitat

Non-fish by-catches occasionally occur in the landings of shrimp trawlers.. The concerned species are normally non-targetted and include sea snails, crabs, squids, annelids such as polychaetes and oligochaetes, bivalves, gastropods and cephalopods, e.g. octopus, squids and very scarcely lobsters. Presently most of these products are not of significant economic importance and are mostly discarded except on special request for domestic consumption and when, occasionally, some companies is trying to find export markets, for instance for cephalopods and crab legs. Trawler operators indicate the

seasonal occurrence of the molluscs and crabs: Crabs are common between May and October and about 1-1½ MT may be caught on a trip. Molluscs are caught between November and April with 2-3 MT per fishing trip. The impact of shrimp trawling fisheries on these invertebrates is not well documented and full scientific investigation into species composition, quantities, implications for biodiversity and potential value would be necessary.

Outrigger vessels using two or four trawl nets are bound to continuously sweep over the bottom of the sea-bed with the tickler chains stirring up the bottom thus destabilising both the infauna that live buried in the sand or mud and the epifauna which inhabit the surface of the bottom. The constant trawling activities in the shrimping grounds disturb the eggs and larvae growth and population development. Their destruction or destabilisation could have adverse effect on the ecosystem and thereby trigger migration to relatively sheltered or protected areas. The areas in-between underwater oil installations have become comparatively rich fishing/trawling grounds for experienced captains.

It is worth noting that greater impact on living marine resources and the habitat probably result more from oil prospecting and other human activities such as uncontrolled urban and industrial development accompanied by untreated solid waste disposal, filling and dredging activities, pollution, oil-well blow outs, etc. Notwithstanding, more specific research should be carried out on the real impact of trawling for shrimps on bottom habitat and benthic communities.

## 6. PERCEPTION

### 6.1 Perception of the present shrimp exploitation situation including the environmental impacts

Perceptions differ among individuals, groups and actual operators in the shrimp trawling industry. Fisheries scientists and development officers perceive imminent dangers to the sustainability of inshore trawling fisheries because of the decline in the average size of the commercial fish which are landed and the increasing quantity of small-sized or juvenile fish in fish by-catches. The gradual replacement of catch of good quality and value fish as in the past by less valued miscellaneous fish (locally referred to as MIX) is a typical, serious, sign of over fishing. However, it appears that as long as investors continue to get handsome returns on their capital investments they believe that all is still well. The obvious shift from fishing to shrimping in the late 1980's by the investors coupled with their current favourable disposition to increasing fishing efforts confirm such position and interest in earning highly valued foreign exchange. Notwithstanding, all parties favour an early introduction of closed areas based on incontrovertible scientific basis to select the area to be closed and duration of closure.

### 6.2 Other fishermen

Despite the prohibition of trawling by shrimpers in the 5nml of the territorial waters down to 18 m depth, conflicts are still rampant between industrial and artisanal inshore fishing operators. Thus, the canoe fishermen complain vocally against destruction and towing away of nets, ramming of canoes and threats to their very existence by commercial operators. They perceive shrimp trawling operators as not paying any attention and being, even, harmful to the resources and affecting their fishing rights. Nevertheless, booming fish by-catch marketing transactions, mostly comprising juveniles of commercial species and naturally small-sized adults of various fish species have developed among the coast between canoe and trawler operators. Fish merchants are obviously deeply involved in this business and, according to artisanal fishermen, there would be some smuggling.

### 6.3. Environmental Organisation/Non-governmental Organisations (NGOs)

The newly created Federal Ministry of Environment (formerly the Federal Environmental Protection Agency-FEPA) associates the problem of impact of shrimp traling fisheries to the compliance with the Code of conduct for responsible fisheries and sustainable practices. Some NGOs exist and show interest in the conservation of National resources, but concentrate more on oil pollution, and other habitat alteration and degradation. In Bayelsa and Delta States, the Niger Delta Wet Land Centre had shown concern over trawlers menace, capture of juvenile fish and dumping of discards at sea. The Friends of the Environment (FOTE) and the Nigerian Conservation Foundation (NCF) perceive fishing as one of the human activities disturbing the ocean ecosystem and reducing biodiversity.

### 6.4 The authority

The Government agencies on Fisheries (Research and Development) and Environment have consistently shown concern about the effects of shrimp trawling fisheries on the marine ecosystem and biodiversity. It is perceived that effective regulatory and management measures must be put in place to reduce juvenile by-catches in fishing operations or prevent catching of juveniles altogether and protect nursery grounds, among other things. The prevention of excessive fishing/shrimping in the inshore waters can be achieved by the re-deployment of the Nigerian Industrial fleet to exploit the offshore pelagic and deeper water resources or operate under licence on other rich fishing grounds in the sub-region. These are perceived as possible viable options.

### 6.5 Knowledge about new environmentally friendly techniques and practices by the shrimping industry

The practical knowledge of By-catch Reduction Device (BRDS) of soft/rigid type is scanty but theoretical knowledge from literature is fair. There is no opposition as such to the use of friendly technologies and devices if loss of valuable shrimp products does not accompany the adoption of such techniques. However, one or two operators are quite open to innovations in gear design and construction with a view to allowing better gear selectivity and escapement of small-sized fish species. Modified nets having 60–70 mm meshsize in the codends were testedfor shrimping trawls and the interviewed skippers using these modified nets confirmed that there is no significant drop in shrimp landings but there is a reduction in juvenile by-catch. It was also observed was some saving in fuel consumption. With the success of this private initiative a multiplier effect within the industry can be expected since other fishermen are usually keen to follow successful experiment.

## 7. SOCIAL IMPLICATIONS OF ADJUSTING SHRIMP FISHING TO MORE ENVIRONMENTALLY FRIENDLY PRACTICES

The effects of introducing more environmentally friendly devices into the shrimp trawling fishery will bear on the gains or losses experienced by various concerned groups or individuals. The possible adjustments include the introduction of bigger codend mesh sizes for fishing nets, installation of By-catch Reduction devices (BRDs) and the enforcement of laws preventing the sale and purchase of certain prohibited sizes of fish and other products. The anticipated consequences/results of such adjustments include a reduction in the landing of juvenile fish and small-sized fish species (which are either sold into coastal rural markets or discarded) and, on medium term, the liquidation of such markets. The immediate reactions of the beneficiaries of such lucrative fish by-catch trade will definitely be negative to any such adjustment. As such, there may be a passive and indirect resistance to change.

Another implication is the possible revenue loss to fishing companies due to an overall reduction in catches and this implies that more fishing efforts will be required to capture economic quantity of shrimps. A successful adjustment to more environmentally friendly practices is bound to protect juveniles of various fish species and the sensitive nursery grounds. Thus, more fish will grow to adult sizes before capture and this will, on medium term, lead to increase of the fish landings, in terms of quantity and value and means of livelihood of the local fishermen and their dependants.

## 8. NATIONAL PRIORITY ISSUES REQUIRING ACTIONS TO MEET ACCEPTABLE STANDARDS OF ENVIRONMENTALLY FRIENDLY SHRIMP EXPLOITATION

Quite a number of national priority issues require attention in introducing more friendly innovative and adaptable shrimp trawling techniques and practices in Nigeria. Intervention in environmental and socio-economic matters requires scientific and detailed understanding of all pertinent issues to enable the development of strategic options. Such issues cover social, financial, research and development, infrastructure, and cost/benefit analysis, among others. Therefore, some of the priority issues listed below need to be addressed:

- Acquisition of appropriate and modern vessels as well as necessary equipment to strengthen research capabilities for the implementation of fisheries resources programme, gear modification and design, etc. as well as the strengthening of the Monitoring, Control and Surveillance capabilities to effectively supervise the shrimp trawling industry.

- The Present Sea Fisheries Decree No 71 of 1992 should be reviewed based on scientific information regarding the status of fish and shrimp stocks. With regard to fisheries management measures, stricter enforcement of pertinent fishing regulations, introduction of closed seasons/closed areas, accurate catch and effortdata to be provided by operators to the Federal Department of Fisheries must be accorded top priority.
- Basic, essential, infrastructure needs (access to victualling, supply of all production inputs and monitoring services, etc.)and conducive environment for the inshore trawling industry should be provided at a centralised operational harbour in Lagos where over 80% active operators are based .
- Campaign to promote responsible practices for inshore fisheries and the need for adoption of more friendly shrimping techniques/practices.

## 9. A PLAN OF ACTION FOR THE DEVELOPMENT OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES FOR SHRIMP EXPLOITATION

More detailed research into the inshore fisheries resources focusing on life history, reproductive cycles, migration pattern, behaviour and the environmental aspect is most desirable before the introduction of any By-catch Reduction Devices or Closed Area. The acceptance of any BRD or closed areas/season in Nigeria would therefore require an action plan featuring the following components:

- Specific research projects activities on the present exploitation patterns, behaviour of shrimps in more friendly shrimp trawl gears, volume and utilisation of by-catches and the effect of shrimp trawling practices on sea bottom and benthic creatures, etc. should be intensified as well as improvement of catch and effort statistical data collection and compilation.
- Local design and testing of models/full sizes soft or hard BRDs under laboratory and field conditions.
- Study of possible and equitable incentives for the introduction of BRDs in particular when the introduction of such devices lead to immediate losses of catch and revenue.
- Study of the socio-economic consequences of the implications of the elimination of existing fish by-catch trade.
- Campaign to dissuade the acceptance of juvenile or under-sized fish by the consumers.
- To put in place most cost/effective National, Regional and Global Monitoring, Control and Surveillance Systems, with air surveillance, that will allow for early detection and apprehension of erring vessels and their crew.
- Strategically located surveillance centres equipped with appropriate modern information/Communication technology should be established at National, and Regional levels where Environmental and by-catch problems are most severe.

## 10. CONCLUSION

In order to introduce effective and acceptable techniques and practices to shrimp trawling industry that would reduce fish by-catch and loss of biodiversity, it is necessary to implement a programme of action which should include the under-listed projects:

(i) Underwater survey (including photography, where possible) and further study of the shrimping ground, ecosystem and ocean floor with a view to ascertaining the degree of disruption and biodiversity loss consequent upon the current and improved shrimping methods and practices.

(ii) Resource surveys of the Nigerian shrimp fishery to assess the current sustainable yield for fish and shrimps; size distribution; species composition, age and more detailed size composition of all by-catches. The surveys will also include an analysis of the detailed composition of non-fish by-catch and their economic importance.

(iii) Exploratory fishing of identified but unexploited tuna and other fisheries resources. Further studies should also be conducted into the tuna fish bait problem and other identified deeper water fish resources to determine economic viability of the exploitation of such resources.

(iv) A comprehensive socio-economic survey of the current status of coastal artisanal fishermen and the possible impact of by-catch trade-reduction amongst the various beneficiaries of the

by-catch (investors, crew, fishing communities and buyers of the by-catches). This is with a view to recommend appropriate action that will not be socio-economically counterproductive.

(v) Designing, fabricating and testing of various By-catch Reduction Devices (BRDs) with a view to adopting workable options that can be introduced for more environmentally friendly shrimp trawling practices.

(vi) Proper training and exposure of adequate number of personnel in Monitoring, Control and Surveillance of the marine resources so as to enforce and monitor whatever management measures now inforced or to be introduced.

(vii) Proper marking of non-fishing and prohibited fishing areas at different times as recommended in the Fisheries laws and management regulations and full information of the concerned fishery operators.

(viii) Review of Government incentive for the marine fisheries sectors (import tax reduction, credit policies, provision of vital basic infrastructure, etc.) after comprehensive studies on the economics of industrial marine fishing business. The ultimate goal is to broaden the Nigerian fish supply base through the exploitation of t, una, other pelagic and meso-pelagic resources available within the Nigerian EEZ and to promote genuine Nigerian investment in long distance fishing on rich fishing grounds where fishing rights agreements are being negotiated with some other African countries.

**REFERENCES**

*Aderounmu, A.A. (1997)* Nigeria Fisheries with emphasis on Resources, production, controls and fishery products' exports and imports

*Ajayi, T.O. and Talabi, S.O. (1984)* The potential and strategies for optimum utilisation of the Fisheries Resources of Nigeria. Technical Paper No. 18 Nigerian Institute for Oceanography and rine Research, Lagos

*Ajayi, T.O. and Adetayo, J.A. (1982)* On the fish by-catches and discard of the Shrimp Fishery of Nigeria. Technical paper No. 5 Nigerian Institute for Oceanography and Marine Research, Lagos

*Ajayi T.O. (1982)* The maximum sustainable yields of the inshore Continental Shelf. Pp. 571-577 Journal of Fisheries Biology (1982) Vol. 20

*Allen, J.R.S. and Wells, J.W. (1962)* Holocene coral banks and subsidence in the Niger-Delta

*Amadi, A.A. (1982)* Species composition, distribution and resource potentials of fishes recorded in bottom trawling between 50-200 m depth off the Nigerian coast

*Anetekhai, M.A. (1991)* Impact of Tropical Shrimping on Living Resources of the Gulf of Guinea

*Bayagbona, E.O. and Ajayi T.O.* – Coastal and Inshore Marine Fishery Resources of *N.I.O.M.R (1980)* Nigeria

*Central Bank of Nigeria (1998)* Annual report and statement of accounts

*Elliott, O.O. (1999)* Proposed FAO Project on the reduction of the impact of Tropical Shrimp Trawling Fisheries on Living Marine Resources

*FAO (1969)* Fisheries Survey of Western and Mid-western Regions of Nigeria

*Federal Republic of Nigeria* Decree No 71 – Sea Fisheries Decree 1992 *Official Gazette No. 71* S.I. 18 – Sea Fisheries (Licensing) Regulation

*Vol. 79 (1992)* S.I. 19 – Sea Fisheries (Fishing) Regulations *Fisheries Statistics of Nigeria,* Federal Department of Fisheries Publication. Abuja *3rd Edition (1995)*

*Isebor, C.E. 1999* Proposed FAO Project on the Reduction of the impact of tropical Shrimp Trawling Fisheries on Living Marine Resources

*Moses, B.S. (1994)* Baseline survey of catch, catch rate and species composition of the artisanal fisheries of the south-eastern Nigeria

*Olaniyi, A.O.A. (1999)* Reduction of the impact of Tropical Shrimp Trawling Fisheries on Living Maine Resources (By-catch and discards reduction and the Environment)

*Otobotekere, A.J.T. (1999)* Reduction of impact of Tropical Shrimp Trawling Fish Fisheries on Living Marine Resources. (Project UNO/INT/724/GEF)

*Raitt (DIFS) and Niveno, R. (1969)* Exploratory prawn trawling of the Niger Delta proc. Symp.Oceanogr.Fish.Res.Top. Abidjan 1966, 403-444

*Ssentongo. G.W.; Ajayi, T.O.;* Report on a Resource Appraisal of the Artisanal and *Ukpe, E.T. (1983)* Inshore Fisheries of Nigeria. FAO Field Document 2.FI. DP/NIR/77/001. Rome

*Tobor, J.G. and Ajayi, T.O. (1991)* Highlights of achievements in the last 30 years by the Nigerian Institute for Oceanography and Marine Research and its Parent Research Division of the Federal Department of Fisheries, Lagos

*Dublin-Green, J.G.* Marine Resource and activities in Nigeria. Technical Paper No. 84 Nigerian Institute for Oceanography and Marine Research, Lagos.

*Tobor, J.G. (1991)* A Decade (1981-90) of Fisheries Research activities at the Nigerian Institute for Oceanography and Marine Research: Hope for Self sufficiency in Fish Production in Nigeria

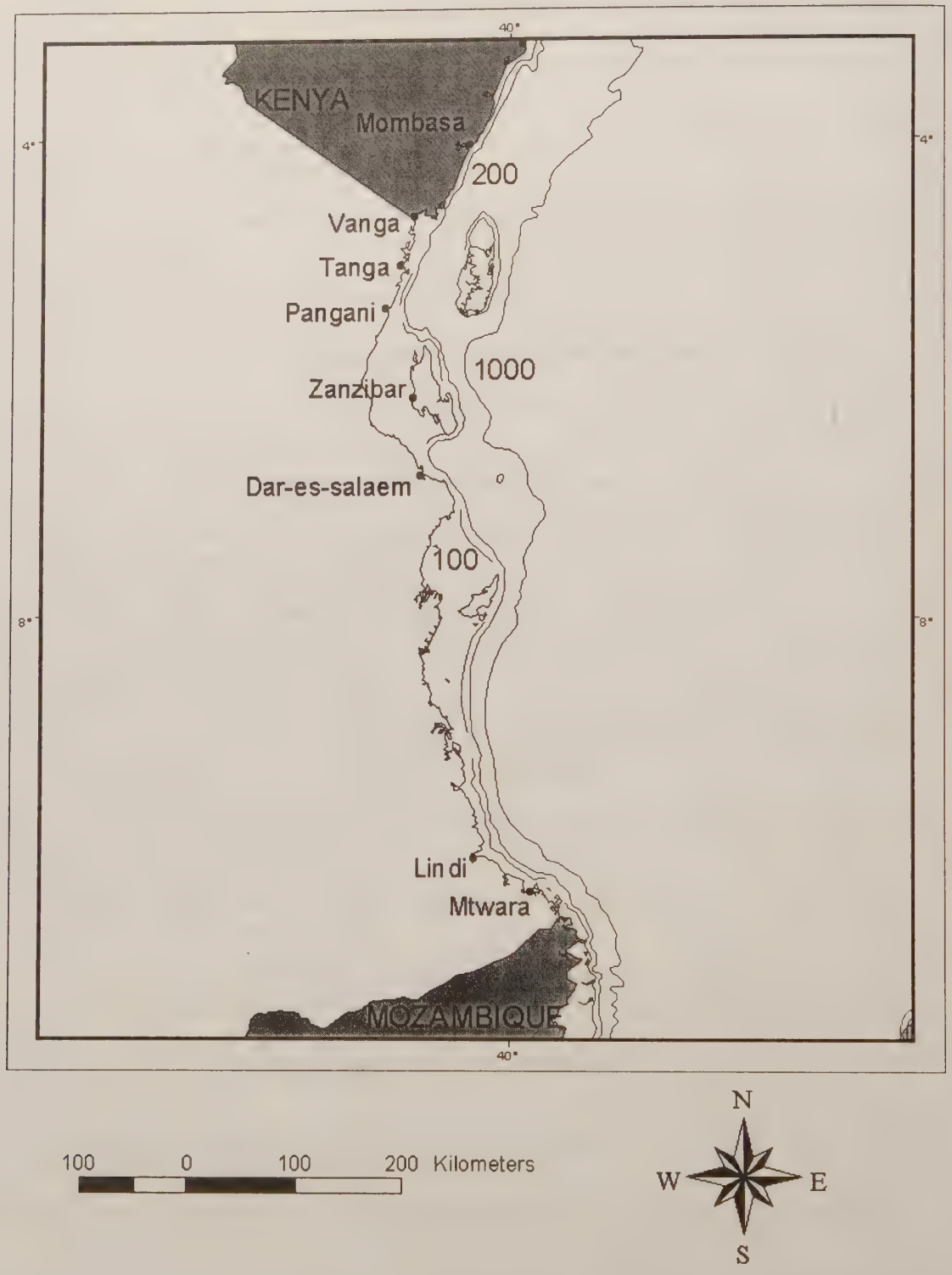
*Udolisa, R.E.K. (1991)* Shrimp Fisheries: information of shrimping Vessels and Gear

*Williams, F. (1968)* Report of the Guinean trawling Survey Vol. 1

## THE UNITED REPUBLIC OF TANZANIA

### REDUCING THE IMPACT OF TROPICAL SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES THROUGH THE ADOPTION OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES IN TANZANIA

By W. V. Haule; National Coordinator (Fisheries Division; Ministry of Natural Resources & Tourism; P. O. Box 2462; Dar Es Salaam; Tanzania; Fax: 255-51-110352; E-mail: fisheries@twiga.com).



Abstract

The shrimp catch reported by trawlers in 1998 was almost 1 000 t. The white prawn (*Penaeus indicus)* makes up 66% of the catch, giant prawn (*P.monodon)* and tiger prawn *(P. semicsuecatus)* 18% and brown shrimp (*Metapenaeus nonoceros)* 15 %.

By regulation all the fish caught are supposed to be retained for local sale. However, the total amount of discards is unknown.

In 1998, 17 industrial trawlers, mostly foreign owned, were licensed. A recent regulation limits the power of the engine and the tonnage of shrimp vessels. The mesh size in the codend is 50 mm.

The fishing season is from March to November only and night trawling is prohibited.

Most of the time the vessels operate within 1-6 nautical miles from the coast; three zones were demarcated for spreading the fishing effort on the fishing grounds on a monthly rotational basis.

The artisanal fishers consider trawling, in particular in coastal areas, is a serious problem: large catches of juvenile fish which are the basis for the recruitment of resources exploited by the non-industrial sector and a decline has already been observed in the artisanal catches in areas where trawlers have operated.

Resumen

Las capturas de camarón reportadas por los arrastreros en 1998 fueron de casi 1.000 toneladas métricas. El camarón blanco (*Penaeus indicus*) constituye el 66% de la captura, el camarón gigante (*P. monodon*) y el camarón tigre (*P. semicsuecatus*) representan el 18%, mientras que las capturas del camarón marrón (*Metapenaeus nonoceros*) alcanzan el 15%.

Según lo establecen las regulaciones, todo el pescado capturado debería ser retenido para la venta local. Sin embargo, se desconoce la cantidad total de descartes.

En 1998, se otorgaron licencias a 17 arrastreros industriales, la mayoría de estas embarcaciones son propiedad de extranjeros. Una regulación reciente limita el poder de la maquinaria y el tonelaje de las embarcaciones camaroneras. La abertura de malla en el copo es de 50 mm. La temporada de pesca se inicia en marzo hasta noviembre y se prohíbe la pesca nocturna.

Las embarcaciones operan la mayor parte del tiempo dentro de las 1-6 millas náuticas de la costa; en las áreas de pesca se demarcaron tres zonas para diseminar el esfuerzo de pesca sobre la base de una rotación mensual.

Los pescadores artesanales consideran que la pesca de arrastre, particularmente la que se efectúa en las zonas costeras, es un problema serio: grandes volúmenes de capturas de juveniles que constituyen la base del reclutamiento de los recursos explotados por el sector no industrializado y un declive ya evidente en las capturas artesanales, en las áreas donde operan las embarcaciones de arrastre.

## 1. INTRODUCTION

Tanzania lies South of the equator between $1^0$S – $11^0$ 45'S and $29^0$ 21'E – $40^0$ 15'E and is the largest country in East Africa. It has a coastline of about 800-km of the Indian Ocean, which covers five administrative regions namely Tanga, Coast, Dar Es-Salaam, Lindi and Mtwara. The coast has a narrow steeply falling continental shelf estimated to be about 17 500 $km^2$. The continental shelf is about 5.8 km, except the Zanzibar and Mafia channels where the continental shelf reaches a width of about 62-km.

The fisheries are mainly artisanal, producing about 85% of the annual fish landings, concentrated close to the shore due to the limited range of the craft at the disposal of the fishermen.

About 2% of the population is engaged in fishing along the coast. The marine fisheries employs about 15 000 artisanal fishermen operating with a total of about 3 200 fishing vessels (mostly canoes) and landing an average of 36 700 tonnes of fish and about 700 tonnes of prawns per year. Both, artisanal fishermen with small crafts and industrial prawn trawlers participate in the harvesting of the marine resources, especially in prawn fisheries. The small-scale fishermen only fish in the very shallow waters (less than 3 m deep) while trawlers fish in areas ranging from the coast to more than 20 m deep. Fish contributes over 60% of protein consumption of the coastal population. Coastal communities depend on fishing as their main source of income.

Available marine fish resources are not well known. The fishery resources surveys carried out by the Norwegian research vessel R/V Dr. FRIDTJOF NANSEN in 1982/83 estimated the standing stocks of marine fishes in waters over 20 m depth to be between 100 000 and 175 000 tonnes. The potential yields were estimated to be between 25 000 and 44 000 tonnes per year. The catch composition of fish during the trawl surveys consisted of small pelagic, mainly sardines, carangids, scombrids, silver biddies and prawns. Annual yields as estimated by FAO (1984) were about 38 000 tonnes/year for demersal species and about 23 000 tonnes for pelagic species, such as sardines and small tuna. This gives an overall estimate of 60 000 tonnes per year for commercial marine fish resources for the territorial waters.

The Artisanal fisheries in inshore shallow waters produce about 85% of the annual fish. The productive fishing grounds include coral reefs, sea-grass beds and reef flats. These areas experience very heavy fishing pressure and show now signs of over exploitation.

The demersal fish species auch as . breams, groupers, parrotfish, snappers, rabbit fish, emperors, sharks and rays dominate the marine catches. These are caught using hand lines, traps and nets. The small pelagic fishes consist primarily of sardines, small tuna and mackerel. These are caught mainly using purse seine nets or ring nets. Large pelagic, such as kingfish, tuna, sailfish and marlin are caught by surface gillnets and trolling lines. Other species include octopus and lobsters, which are usually hand collected from reef flats at low tide by divers. Sea cucumbers and cockles are caught using trawl nets hand lines, seine nets set nets, etc. Prawns or shrimps are caught in estuaries by shrimp trawlers or with seine nets.

## 2. THE SHRIMP FISHERY

### 2.1 Shrimp Resources

Five *penaeid* species contribute to the Tanzanian shrimp fishery. The white prawn *Penaeus indicus* makes up to 66% of the catch, 18% are giant prawn *Penaeus monodon* and the tiger prawn *Penaeus semisulcatus,* 15% are brown shrimp *Metapenaeus monoceros* and the flower shrimp *Penaens japonicus* makes up 1%.

The maximum sustainable yield i.e. potential annual catch has been estimated for shrimp at between 1 050 and 1 400 metric tonnes.

The shrimp fishery is located in three major areas namely Bagamoyo area extending from $05^0$ 30'S to $06^O$ 30'S; Kisiju area from $07^O$ 05' to $07^O$ 45'S and Rufiji area from $08^O$ 00' to $08^O$ 40'S (Figure 1).

Kisiju area is the most productive shrimp fishing ground, contributing 45% of the annual catch. Bagamoyo fishing ground contributes 25% and Rufiji area contributes 30.% of the shrimp annual catches.

The Bagamoyo area is fed by freshwater from the Pangani, Wami and Ruvu rivers (Figure 1). Tributaries from the Rufiji River (Figure 1) feed the Kisiju and Rufiji areas. The peak outflows of these rivers occurs between March and May, with the exception of Pangani which has a constant run off, accompanied with shrimp peak catches during the months of April, May and June. The fresh water outflow of these rivers is very much restricted to the inshore waters during the South west monsoon (which lasts from April to October) because the wind blows from the south parallel to the coast and thus deflects water to the left piling it up along the coast (Ekman transport) (Iversen *et al*, 1984).

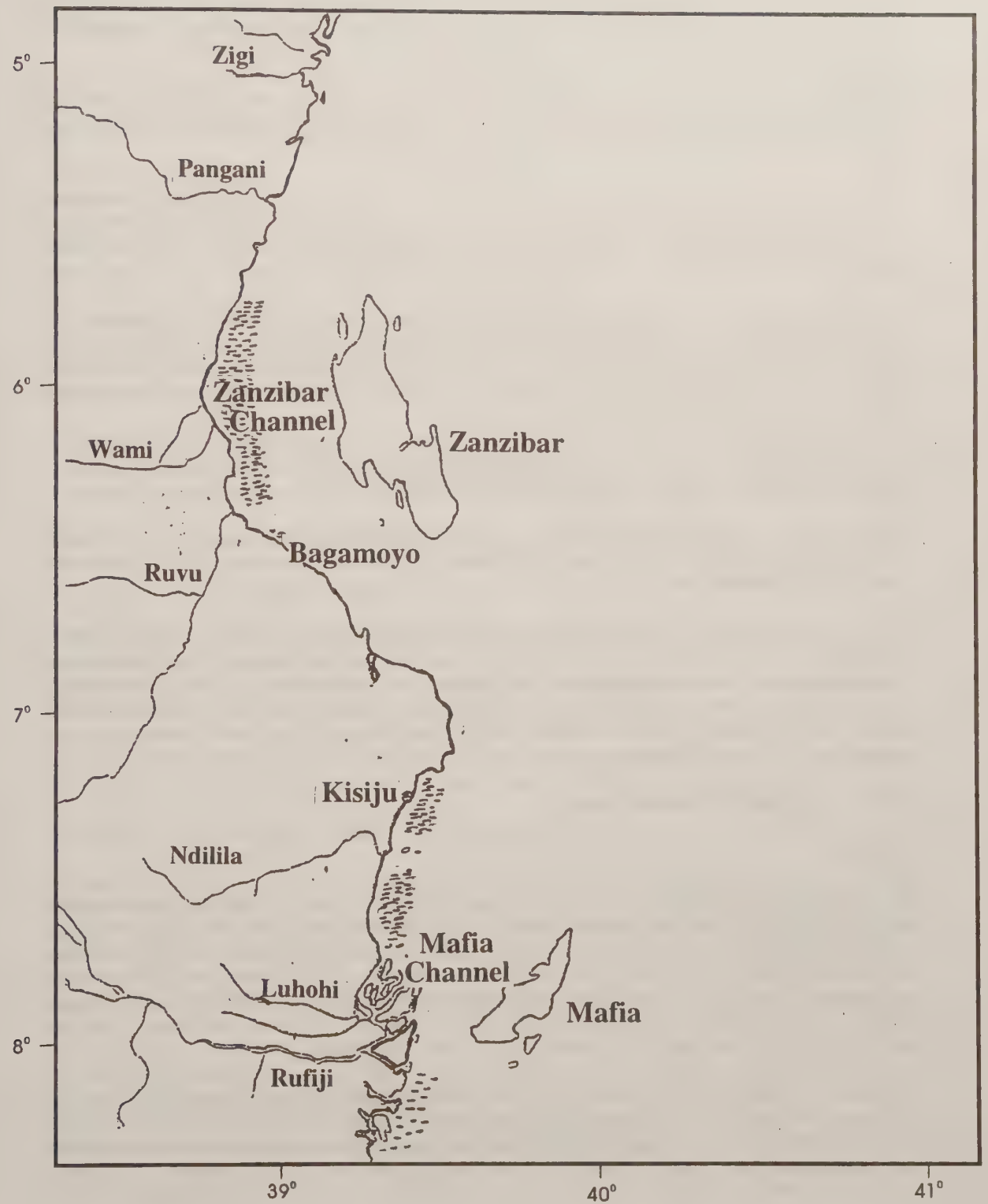



**Figure 1. Shallow-water shrimp fishing grounds and surveyed areas off the Tanzanian coast**

## 2.2 Fishing methods and practices

### 2.2.1 The Artisanal shrimp fishery

The dugout canoe, locaaly known as *mtumbwi* is the most commonly craft in use in small-scale fisheries; it is propelled by oars and poles or, if operated in the open waters, occasionally equipped with sails. Planked boats equipped with sails and/or outboard engines are employed as well.

"Mesh nets" and seine nets are the predominant gears. Both mesh nets and seine nets are made of nylon yarn with mesh sizes ranging from 1 to 2 inches and 1/16 to ½ inches respectively. Mesh nets are usually two ply and the seine nets range between six and eight ply.

There are two types of "mesh nets" with different mean lengths of 113 yards (103 metres) and 378 yards (344 metres). The former is mainly operated from dugout canoes while drifting with one end attached. The latter is set across channels within the inter-tidal zone. "Mesh nets", held between two mangrove poles are frequently towed by two persons operating on foot.

Other nets very similar to the above mentioned ones, small seine nets locally known as "*chandalua*" or "*tandio*", 10 and 20 yards (9 and 18 metres) long, are also very common; larger seine nets, "*nyavu*" are often more than 50 yards (46 metres). Such seine nets are most of the time operated by two persons either on foot or with a dugout canoe. Wooden bars are attached at each end and the fishermen drag the nets in the shallow waters during low tide.

Fishing methods also include cast-nets, beach seines, lift nets and mosquito nets. The use of pots is reported in some areas, whereby maize and rice husks as used as a bait.

Mosquito nets ("*chandarua/tandio*") which are somewhat similar in design to beach seines although made of mosquito netting and generally much shorter in length, are commonly used by women for seining in the shallows during low tide.

Various forms of traps are set on the seaward side of the inter-tidal zone for trapping shrimp during the outgoing tide: - "*uzio*", which are fixed trap consisting of long fenced screens made from poles cut from mangrove trees, narrowing into a gate – way leading to a catch chamber; - "*wando*", another fixed trap similar to the "*uzio*" but made of manufactured materials such as wire mesh or nylon netting. Another type is "*utanga*" which is a barrier made of mangrove poles used in the small creeks and channels at the edges of the mangroves.

### 2.2.2 Industrial shrimp trawl fishery

**The Gear**

Floridian rigging commonly known as double rigg trawling or outrigger trawling is the predominant method used by shrimp trawlers: two similar trawls are towed at the same time, one of each side of the vessel. More than 80% of the trawlers use the 4 seam semi-balloon net designs. The net webbing material for the body of the shrimp trawls is PE 360d – 400d/3. The wings and the body have mesh sizes ranging from 50 to 55 mm. Most vessels shoot a try-net before shooting the standard shrimp trawls. The try-nets have 3-5 metres head rope and are used with miniature otter boards of 0.3–0.6 metres. Most of the trawlers use rectangular, flat, wooden, otter boards .

The boards are directly attached to the wings. Four chain bridles are then used to attach the otter board to a wire bridle that runs to the main towing warp. The bridles are, in general, 16mm in diameter and 60-70 m in length. The main warps are 18–20 mm diameter wires. Eighty five percent of the trawlers use combination wires for their ground ropes, sizes ranging from 16-18 mm in diameter. The rest use steel wire covered by PP rope.

Ballasting is done by chain. Short link chains are used to tie loops along the ground rope at 30-45 cm intervals. The loops constitute 9-12 links of chain. The fleet popularly uses tickler chains.

There are no by-catch reduction devices on the trawls.

**The vessels**

The majority of the shrimp trawlers are double rig, outrigger trawlers. The outriggers/booms are normally made of steel and are 8-12 metres long. The side booms, center boom and center mast are located at mid-ship. The vessels are usually single–decked with crew quarters in the fore body and fishing activities being carried out on the main deck in the aft.

Color video sounders are popularly used as a fish finder on the vessels. All trawlers carry SSB and VHF radios. The vessels have no shrimp sorting machines. Almost all vessels possess blast freezers and freezing hold. The holding temperatures in the fish hold range from –21°C – 35°C.

Most of the time, the vessels operate within 1-6 nautical miles from the coast at depths ranging between 3 and 20 metres.

The engine power of the vessels is ranging from 220 HP to 992 HP and the lengths from 17.6 to 38.1 m while the Gross Registered Tonnage is between 45 GRT and 296 GRT.

To date the engine horsepower has been by regulation limited to not more than 500 HP and and the Tonnage of the shrimp trawlers not more than 150 GRT.

Table 1 gives vessels specifications that have been operating over the years.

The shrimp trawlers operate within 1-6 nautical miles from the coast at depths of 3-20 metres. The vessels are rationally divided into three groups and made to fish on the three fishing grounds (Figure 1) on monthly rotational basis.

Both industrial and artisanal fisheries share the shrimp resource in the same waters.

## 2.3 Effort data by fishing method

A shrimp Fishing Unit (SFU) is defined as the combination of fishing gear, crew and often although not always, a fishing boat, targeting the shrimp stock on the shallow water fishing ground. The annual mean number of fishing days per SFU in the Tanzanian artisanal fishery is about 250 days but the number of Shrimp Fishing Units and catch rates are still to be studied in detail.

However, SWIOP/MNRT made some survey of the artisanal shrimp fishery in 1990. The estimate was some 859 Shrimp Fishing Units , with annual mean number of 160 fishing days per SFU .

The Fisheries Division mentions 250 fishing days per year in the artisanal fishery statistics.

Regarding the catch, a serious discrepancy is observedbetween the SWIOP/MNRT estimate, in 1990, for the annual catch of 1 923 tonnes for shrimp (all species) and 1,121 tonnes for the white and tiger shrimp while the official statistics of the Fisheries Division give the shrimp catch by the artisanal fishermen as 536 tonnes (1988) and the exports as 247 tonnes.

Table 2 gives the number of shrimp trawler, number of fishing days and shrimp and fish catches over the years.

The number of shrimp trawlers had a pick in 1995; it was 17 in 1998 and in 1999, the number to licensed shrimp trawlers during standed at 20.

This number of shrimp trawlers is likely to increase in the years to come.

## 2.4 Shrimp catches

Commercial trawling for prawns in the Tanzanian waters commenced in 1969 after an exploratory fishing survey carried out by a Japanese trawler from June to December 1968 but the shrimp trawl fishery mainly developed after 1982 with the acquisition of trawlers by the parastatal organization - Tanzania Fisheries Company (TAFICO).

**TABLE 1: Vessel Specification**

| Vessel | Total length (m) | Gross Registered Tonnage (GRT) | Engine Horse Power (HP) |
|---|---|---|---|
| KIRKI | 38.10 | 256.36 | 992 |
| AIMILIA | 38.10 | 256.36 | 992 |
| ODYSEAS | 28 | 155 | 495 |
| ARUSHA | 24.77 | 44.7 | 495 |
| SEASHORE 1 | 17.6 | 45 | 240 |
| SEASHORE 2 | 17.6 | 45 | 240 |
| KATARINA | 37.2 | 293.13 | 835 |
| MAMA OTAN | 28.5 | 149 | 800 |
| BANUSO 2 | 21.8 | 140.26 | 450 |
| BANUSO 3 | 24 | 140.26 | 540 |
| SPYRIDON | 31.95 | 223 | 700 |
| AL WALY | 24 | 1.5 | 624 |
| MTONI | 18.45 | 139 | 430 |
| SAADANI | 28 | 150 | 500 |
| MAMA TAFICO | 30 | 150 | 500 |
| PANAVEZYS | N/A | 139 | 800 |
| KAVUNA | N/A | N/A | N/A |
| MARISTELLA | 22.8 | 106 | 365 |
| MARIETA | 22.8 | 106 | 365 |
| MAMA I EDA | 25.9 | 120.53 | 465 |
| MALKIAWA | 18 | 339 | 300 |
| BAHARI | 27 | 197 | 800 |
| SERENGETI | 27.0 | 197 | 800 |
| MANYARA | 26.6 | 166 | 624 |
| MARINE 7 | 27.3 | 152 | 550 |
| CHALLENGER | 270 | 197 | 624 |
| KILIMANJARO | 25.5 | 165 | 510 |
| COMMANDER | 24.6 | 106 | 225 |
| HERO 1 | 36.4 | 232 | 820 |
| HERA | 36.5 | 296 | 970 |
| VENTURE | 26.0 | 131 | 390 |
| MARIELENA | N/A | N/A | N/A |
| DHABIAN | 16.86 | 41 | 235 |
| VICROTIA IV | 16.86 | 38 | 235 |
| VICTORIA V | 16.86 | 38 | 235 |
| VICTORIA VI | 22 | 115 | 498 |
| MAENDELEO | | | |

N/A Data not available

**TABLE 2: Number of shrimp trawlers, fishing days, shrimp catches and fish catches over the years**

| Year | Number of Shrimp Trawler | Number of Fishing Days | Shrimp Catch (kg) | Fish Catch (kg) |
|---|---|---|---|---|
| 1988 | 13 | 1476 | 650929 | 988249 |
| 1989 | 13 | 2166 | 688837 | 978501 |
| 1990 | 9 | 1574 | 960686 | 647467 |
| 1991 | 13 | 1315 | 669016 | 460772 |
| 1992 | 15 | 1560 | 663852 | 462852 |
| 1993 | 10 | 1462 | 59211 | 398112 |
| 1994 | 16 | 2513 | 1024,000 | 575806 |
| 1995 | 19 | 2108 | 812128 | 765540 |
| 1996 | 12 | 1779 | 769651 | 598716 |
| 1997 | 16 | 2091 | 699059 | 610498 |
| 1998 | 17 | 2778 | 995564 | 537875 |

Licensing of foreign trawlers was as a result of policy liberalization of the national economy in mid 1980's. Thus licensing of foreign trawlers began in 1987. Three (3) foreign trawlers were licensed in 1987. More substantial influx of foreign trawlers occurred in 1988 and has increased in subsequent years.

Aseady mentioned, the number of operating vessels in 1998 was 17 and, in 1999, 20 shrimp trawlers have been fishing in the Tanzania waters.

The catches of shrimp and fish resulting from the effort by trawlers during the period 1988 – 1998 is given in the Table 3 below.

**TABLE 3. Shrimp and fish catches (in tonnes) by trawlers during the period 1988 - 1998**

| Year<br>Catch | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrimp (t)** | 650 | 688 | 960 | 669 | 663 | 597 | 1014 | 812 | 769 | 699 | 995 |
| **Fish (t)** | 988 | 978 | 647 | 460 | 462 | 398 | 575 | 765 | 598 | 610 | 537 |

The shrimp species from the industrial fishery are

| | |
|---|---|
| *Penaeus indicus* | (white shrimp) |
| **Penaeus monodon** | (Giant prawn) |
| *Penaeus semisulcatus* | (Tiger prawn) |
| *Penaeus japonicus* | (Flower shrimp) |
| *Metapenaeus monoceros* | (Brown shrimp) |

There has been a variation in the percentage species composition according to different reports.

According to surveys in 1985 and 1990, the percentage of *P. indicus* would vary between 60 and 65.9%; *P. onodon* would be around 15% and *P. semisulcatus* 4% or in another report *P.monodon* and *P.semisalcatus* together would be 11%; the percentage of *Metapenaeus monoceros* would be 15 to 20%; finally *P. japonicus* would be 1 to 7% (Concerning this species, it was observed that it consisted mainly in small sized individuals, making insignificant contribution to the total catch and suggesting some over exploitation of the resource).

In the artisanal fishery the shrimp species composition is influenced by the gear type and fishing location. The proportion of white shrimp (*Penaeus indicus*) is greatest when using "mesh nets" that are mainly operated either in the inter-tidal zone or river mouths. The proportion of small shrimp is greatest when using fixed traps such as "*uzio*" or other that are set along the outer edge of the inter-tidal zone. The smaller the mesh size, the greater the catch rate, and the greater the proportion of the small shrimp categories.

### 2.5 By-catches

#### 2.5.1 By-catch rates; its utilization

An analysis of the trawl total by-catches showed that the highest, 116kg/hr, were in the north (Bagamoyo area) and 85kg/hr further south, in Kisiju area (Figure 1).

The species composition of the by-catch and its possible utilization was studied by Nkondokaya (1992).

#### 2.5.2 Shrimp to by-catch ratio

The shrimp to by-catch ratio vary widely from one haul to the other, between areas and period of the year. As already mentioned, there is more by-catch in the north and, consequently, t he shrimp to by-catch ratios are much higher in the Kisiju area than in the Bagamoyo area, with averages of 1:3 to 1:4 in the former against averages of 1:9 to 1:14 in the latter. In both areas there is a general decrease in ratios towards the end of the year.

The observed difference in shrimp to by-catch ratio between the two studied areas may be due to variation in environmental factors. Three rivers flow in the Bagamoyo area whereas the Kisiju area is fed by one river only but having a number of tributaries. Run-off difference is likely to cause difference in salinity, nutrients input and bottom types. These factors are important for the distribution of both shrimp and finfish.

In Tanzania, the seasonal character of catch, although not documented in details, seems to exist. There are two monsoon seasons, viz. the Southwest and Northeast monsoons that last from April to October and November to March respectively. During the Northeast monsoon (November – March) temperatures reach high levels, the wind speed is low and consequently the sea is calm. During the Southwest monsoon (April – October) air temperature is low, the wind is strong and the sea is rough. Heavy rains, which result in more freshwater and organic matter influx occur between March and May. These factors are likely to have an influence on the seasonal character of catch for shrimp and finfish.

### 2.5.3 Total by-catch

In 1989 and 1990 the Bagamoyo area had a larger total by-catch, whereas in 1991 a slightly larger by-catch was caught in Kisiju area.

The total by-catch estimates covering the years 1989 and 1990 were extrapolated using shrimp to by-catch ratio for 1995, assuming the ratio had remained constant throughout the years (Figure 2). This is likely to give a biased estimate. The figures should therefore be considered with caution.

### 2.5.4 Fish discarded

The amount of fish being discarded varies according to fishing areas and there are fluctuations from year to year. In 1989 and 1990, larger quantities of by-catch were discarded in the north, whereas in 1991 there was more discarding in the central area (Kisiju).

**By-catch discarded**

The main reason for discarding fish by the trawlers is their low value relative to shrimp. Because of this

- a small percentage of the by-catch is kept in the limited freezing space, particularly during the shrimp peak season
- the majority of the crewmembers are assigned to the processing of shrimp while just few members process the bulk of the by-catch.

Economic considerations overrule the high protein demand that the fishery could satisfy with some of the by-catch . Selling the by-catch at sea (which is possible) could increase the returns and make the fishery more profitable.

The major by-catch species: *Trichiurus lepturus, Hilsa, kelee, Pellona ditchela, Thrissa, vitrirostris* and *Leiognathus leuciscus* are all discarded. Generally all the small pelagic species are discarded , as well as the fishes of the family *Leiognathidae.* On the other side, *Otolithes ruber, Johnieops sina, Terapon theraps, Sphyraena obtusata* and *Gerres filamentosus* are kept.

More rare species, which are normally kept, are *Carangidae, Haemulidae, Serranidae, Nemipteridae, Lethrinidae, Lobotidae, Scombridae, Sillaginidae, Arridae* and *Muraenesocidae,* sharks and rays (see Annex 1 for the species in these families)

Large volume of discards observed in Bagamoyo area is possibly due to relatively higher proportion of the by-catch than in Kisiju area. Because of low shrimp catch rates in the north (Bagamoyo area) one would expect that more fish is kept. This is not what is observed. Even when some space is available in the fish hold, most of the by-catch is being discarded (Figure 3). This is done purposely so that the vessel can sail to another fishing zone (Kisiju) without coming to the port for landing fish and thus saving time, fuel and port charges.

A collect of the by-catch by local boats residing in the vicinity of shrimp fishing grounds is being done as an option for increasing the utilization of the by-catch and therefore, reducing the wastages, in

general. In some cases the terms of payment is through exchange of food provisions by the local boats with fish. The sale of by-catch at sea is done through authorized fish collectors.

### 2.5.5 Species caught

Nkondokaya (1992) identified around fifty fish species caught with shrimp in Bagamoyo and Kisiju areas. (Annex 1). Sixty one percent of the total species caught were common to both areas.

In both areas, the demersal brackish water species consisted of the large head hair tail *Trichiurus lepturus*, the tigertoolh croaker O*tolithes ruber,* the sin croaker J*ohnieops sina,* the catfish, *Arius* sp. the bearded croaker J*ohnius dussumieri* and the blackspot threadfin P*olynemus sextarius*. The smaller pelagic species consisted of the orange mouth anchovy *Thryssa vitrirostris*, the Indian pellona, *Pellona ditchela* and the kelee shad, *Hilsa kelee.*

The observed species composition indicates a large representation of demersal species. However there was a frequent occurrence of small pelagic species *(Thryssa vitrirostris, Pellana ditchela* and *Hilsa kelee*) in the catch. It is possible that during the day time small pelagic fish concentrate near the bottom.

Although there are more than 50 species in both Bagamoyo and Kisiju areas, some species are found to be in one area only. *Leiognathus leuciscus, Secutor insidiator, Gerres filamentosus, Sphyraena obtusata* and *Fistularia petimba* are mostly caught, around 9 deep, in Bagamoyo where the bottom is sandy. In Kisiju area, where shallower waters and on muddy bottom, the species are different.

### 2.5.6 Species association

In the north (Bagamoyo area), 4 groups of species were identified:

Group 1 is characterized by species known to prefer muddy bottoms. The most dominant species are *Johnieops sina, Trichiurus lepturus, Otolithes ruber and Arius thalassinus.* The preferred depth range is 5-7m

Group 2 is characterized by small pelagic fish (*Pellona ditchela, Hilsa kelee,* and T*hryssa vitrirostris)* associated with a demersal one *Polynemus sextarius*. The preferred depth range is 5-10 m.

Group 3 includes among other *Leiognathus leneciscus, Sphyraena obtusata, Gerres filamentosus, Terapon theraps* and *Secutor insidiator.* These are species of relatively deeper waters that prefer sandy bottoms (Bianchi, 1985). The preferred depth range is 6-12 m.

The other species form an un-defined forth Group.

In the Kisiju area, the study did not give well defined species assemblages (Nkondkkaya, 1992)

## 2.6 Distribution of catches

### 2.6.1 Artisanal fishery

Around 50-60 percent of the quality fish and 31 percent of the other fish are auto-consumed (SWIOP/MNRT 1990). The rest are either smoked or dried for local markets. Small bony fish are preferred as dried product rather than in fresh form, while the fishermen themselves (in the absence of local buyers) often eat larger fish fresh.

Almost all the white and tiger shrimp are sold as fresh product. The small shrimp are often either auto-consumed or dried or smoked for local products.

The shrimp are sold to shrimp collectors who transport them in iceboxes, often made of local wood covered with metal, polyethylene or fibber–glass sheeting. The wooden boxes are insulated with cork. The duration of a collecting trip is about five days. Collecting operations become more difficult during the inter-rain period because of the unfavorable weather and sea condition.

The shrimp production from the artisanal fishermen is exported to more than 27 countries. Some 60 percent are destined to the African region; the remaining percentage of the exports is destined to Singapore, Mauritius, United Kingdom and Italy.

### 2.6.2 Industrial fishery

Catches from the industrial trawlers are processed on board, including sorting by species and commercial size, grade, packaging into 2kg boxes and freezing. Most exports are made to the European Union countries and Japan

The by-catch is sold to fish collectors at sea or auctioned at open market at Dar Es-Salaam port, after a fishing trip, which usually lasts for about 30 days. However, logistics involved in collecting the by-catch at sea is a limiting factor. Transport costs are high

## 3. REGULATIONS AND MANAGEMENT MEASURES

The legislation on fisheries resources conservation is contained in the Fisheries Act No. 6 of 1970 and its Principal Regulations of 1989.

The Fisheries Act. No. 6 of 1970 concerns exploitation and conservation of the fisheries resources in the jurisdictional waters (including both Territorial and the Exclusive Economic Zone) of the United Republic of Tanzania (URT).

The Law empowers the Minister responsible for fisheries to make such regulations as:

- Prohibiting or restricting the use of explosives, poisons and toxic substances for the purpose of fishing
- Prohibiting or restricting fishing (by whatever means) for immature fish
- Preventing obstruction and pollution of jurisdictional waters
- Providing for protection of Territorial waters
- Prohibiting, regulating or controlling the activities of foreign fishing vessel(s) within jurisdictional waters, and
- Establishing marine parks, sanctuaries or reserves for any purpose whatsoever.

The Fisheries Principal Regulations, 1989 of the Fisheries Act No. 6 of 1970 provide and empower the Director of Fisheries to make, introduce or attach conditions on the fishing license that deem necessary for the purpose of management and conservation of the fisheries resource. By law, the Director of Fisheries is the Licensing Authority. The licensing Policy recognizes that prawn resources being biological entities are finite and hence limited.

Management actions aimed at the conservation of the prawn resource include:

- Limitation on the number of vessels
- Limitation of the engine power to 500 HP and the Gross Registered Tonnage to 150 GRT
- Prohibition of trawling between 6.00 p.m. and 6.00 a.m .(No night fishing)
- 3 zones delimited where vessels are assigned to fish designated in on monthly rotational basis
- Closed season from December to February
- Minimum cod-end mesh size

**(a) Limitation of number of vessels**

The objectives are the attainment of the maximum sustainable yield (MSY) and the maximization of foreign currency earnings. In deciding the number of vessels to be licensed, the MSY is presumed to be between 1 000 and 1 400 tones, as put forward in a joint exercise involving the Fisheries Division and the FAO Project (RAF/87/008) .

**(b) Engine power limitation**

Licensing of trawlers is restricted to engine power of not more than 500 HP. The objective is to minimize environmental damage. The vessels are thoroughly inspected before license is granted.

**(c) Prohibition of fishing at night**

These gives "breathing time" to the environment and give a chance to other groups of fishermen to exploit other resources present in the area. This rule has a great socio-economic impact because it minimizes conflict between small-scale fishermen and the industrial fishery.

This rule gives also a chance to marine turtles to reach the beaches at night for laying their eggs. Anyway, fishermen are called upon to set sea turtles free whenever they are caught in their trawls or other nets.

**(d) Zoning and rotation of vessels on fishing grounds**

The objective is to evenly spread the effort over the fishing grounds.

**(e) Closed season**

The closure of fishing from December to February aims at protecting the young recruits. The months of December to February are a period of most intense recruitment.

**(f) Minimum cod-end mesh size**

The introduction of a minimum cod-end mesh size is being considered as a means of allowing the small shrimp to escape capture. The underlying presumption is that greater yields could be achieved by re-capturing them when they are larger. In practice it is possible that such a requirement may prove being ineffective in allowing escape; for instance, when the meshes became clogged with debris such as weed or mud. Cod-ends for industrial shrimping should not be less than 50 mm stretched mesh size.

Other management measures of the shrimp trawling industry include:

**Retention of fish by-catch**

It is specified to shrimpers that all the fish caught is to be retained on board the vessel for local market.

**Observers**

A licensed fishing vessel may at any time be required to accommodate an observer. At any one time, there is an observer in each of the fishing ground who is able to communicate with the other fishing vessels in the area.

**Catch statistics**

All fishing vessels are required to submit fisheries statistics including catch effort data, fishing locations, etc. on special forms which have been designed for this purpose.

**Licensing**

For a vessel to be granted fishing rights, three licenses are required: one for the fishing vessel itself, the second for shrimp fishing and the third for finfish harvesting.

## 4. RESEARCH ACTIVITIES (PAST AND PRESENT)

The Tanzania Fisheries Research Institute (TAFIRI) has conducted a survey on the prawn fisheries of Tanzania. The aim of the survey was to analyse the the composition of the catch and by-catch. It is observed that most of the catches include both juvenile of prawns and fish. The juvenile prawns are always thrown over-board as they do no fetch good market. Off the fish by-catch, the crew members usually keep a small portion of it, mainly table fish and, as room to keep prawns is needed, the rest of the by-catch is discarded.

The survey carried out confirms that a good percentage of prawns caught by trawlers are sub-adults and most of the small fishes are either juveniles or considered trash (while they are consumed by local communities). The report recommends the use of "fish rejection/excluder devices" that should separate prawn from fish and allow small fish to escape.

Very little work has been done on such devices for the Tanzanian shrimp trawling fisheries. The ratio of by-catch/shrimp mixtures is high. Separation of shrimp from fish is still a problem to the trawlers. Separation is done manually on deck and hence time consuming with some risk that prawns be spoiled before a long sorting..

However, the Tanzania's Mbegani Fisheries Development Centre carried out some studies on prawn selectivity by applying a large separator panel with two cod-ends.

Results showed that there was a drop of up to 30 percent of the total fish by-catch. The prawn catch was also low comparatively (no figures available). Some fishes (especially the pony fish *Leiognathus* spp. managed to filter along side the prawns.

A study carried out by Nkondokaya (1992) is perhaps the only comprehensive research on the by-catch in the Tanzanian shallow-water shrimp fisheries. The pilot study was carried out with the following objectives:

- estimate the quality of the by-catch taken by the shrimp fleet during the study period;
- estimate the shrimp to by-catch ratio;
- estimate the quantity of fish discarded, on the basisof the shrimp to by-catch ratio, the catch statistics of shrimp and the fish which is landed;
- determine patterns of species association in the catches, based on the sampled trawl hauls;
- determine the species composition in the catch and by-catch and the species relative importance by weight, numbers and frequency of occurrence;
- estimate the level of mortality for selected by-catch species;
- suggest sampling methods, which could improve the monitoring of the by-catch.

## 5. IMPACT ON THE SHRIMP RESOURCES OF PRESENT EXPLOITATION PATTERN

Both artisanal and individual fisheries share the same shallow water prawn resource.

In the artisanal fishery small mesh size nets and mosquito nets are used. It is evident that the smaller the mesh size, the greater the catch rate and the greater the proportion of the shrimp in the catch. SWIOP/MNRT (1990) estimated that annual catch for shrimp (all species) was at the tune of 1 923 tonnes and the white and tiger shrimp contributed 1 212 tonnes to the total. The contribution of small shrimp was, therefore, 711 tonnes. These estimates were greater than anticipated, because the official statistics of the Fisheries Division, in 1998, evaluated the shrimp catch by the artisanal fishermen tos 536 tonnes () and the exports to 247 tonnes.

Artisanal fishermen are known to operate with small mesh size nets either in the inter-tidal zone or river mouth areas that are nursery grounds for the small and otherwise immature shrimp. Juveniles are

abundant in these areas. The use of small mesh size nets is likely to reduce the catch of shrimp at first maturity. This reduces the opportunity of catching mature and big sized prawns that would fetch higher prices.

The catching of small prawns reduces the size of the following population.

In respect to the prohibition of night fishing, it was mentioned above that it was introduced as a contribution towards minimizing the conflict with the artisanal fishermen operating on the same grounds. It was however observed that, in Madagascar, (nearby to Tanzania) the catch rates applying to both larger and brown shrimp (but not the white shrimp) are highest at night time, and it is only during the early months of each season that fishing occurs during the day time. This would suggest that there is a component of the shrimp resource i.e. the tiger which is not fully exploited.

However, the experience gained over the years after the introduction of the industrial shrimp trawlers has shown that there is no room to expand the fishing effort because the stock would not sustain it.

## 6. IMPACT ON FISH RESOURCES OF THE PRESENT SHRIMP EXPLOITATION PATTERN

By-catch Reduction Devices are not used in the industrial trawl fishery. All the fishes that are in the trawl net are caught. Few of the fishes are retained on board, but the major part is discarded dead. In this way industrial trawl is wasteful of the fisheries resources.

Since the beginning of the trawl fishery, artisanal fishermen have observed a reduction in their catches: Less fish would be available for the artisanal fishery because of the wasteful practices of the trawl fishery with large discarding.

The rate of depletion of fish resources from the trawl fishery is greater than that from the artisanal fishery.

Based on the literature, some of the species caught and discarded e.g. *Johnieops sina*, *Terapen theraps*, *Gerres filamentosus* and *Leiognathus leuciscus* are small predators feeding on juvenile shrimp (and other bottom invertebrates).

Considering that:

- The rate of depletion of the fishes including the shrimp predators from industrial trawl discards is high.

- The greater population of the small shrimp category results from the use of small mesh size gear in the artisanal fishery.

Then the declining population of the fishes as a result of trawl fishery is left with declining juvenile shrimp to feed on. This is likely to have a reduced rate of the fish population reproduction as a result of reduced juvenile shrimp food.

## 7. THE IMPACT ON NON- FISH BY-CATCH OF PRESENT FISHING PRACTICES

Non-fish by-catch of economic importance caught from shrimp trawling fishery include:

Crabs: mainly *Scyla serrata,*

The major part of the crabs captured by the shrimp trawlers are discarded, some dead, other alive. Other crustaceans, some of the big sized *Scilla serrata*, are eaten on board.

Cephalopods: - Cuttlefish: *Sepia pharaonis*, the Pharic cuttlefish and *S. prashad*, the hooded cuttlefish. - Squids: *Loligo duvauceli,* the Indian squid and *L. forbesi,* the veined squid

All these cephalopods, squid and cuttlefish, are retained on board for consumption. Their magnitude is not of sufficient quantity to warrant them sale at fish markets.

Turtles: Five species inhabit the Tanzanian marine waters. These are:

*Caretta caretta,* the pacific loggerhead turtle
*Chelonia mydas,* the Pacific green sea turtle
*Eretmochelis imbricatta bissa,* the hawkibill turtle
*Lepidochalis olivacea,* the Pacific ridley turtle and
*Dermochelys corriacea schlegelli*, the pacific leatherback turtle

The sea turtles have occasionally been cited as caught in trawls, few dead but, most of them, alive. Sea turtles are protected by law and fishermen are called upon to set sea turtles free whenever they are caught. This seems to be the practice.

Non-fish resources, not of commercial importance that make way into trawls include, every now and then, sea-urchins, bivalves, worms and some other benthic organisms and discarded . For these organisms, which arrive dead on the deck, no potential utilization has been found and these are, therefore, discarded.

## 8. THE IMPACT ON THE BOTTOM HABITAT OF PRESENT FISHING PRACTICES

Tickler chains are attached to the groundrope of trawl nets, dragged over the sea bottom to drive shrimp into the codend.

The nature of the bottom habitat differs according to fishing grounds. Bagamoyo fishing grounds have a sandy bottom seabed. Kisiju and the rest of the southern area have a muddy bottom because of a high siltation process of the adjoining river delta.

Sweeping tickler chains and otter boards of the shrimp trawls plough over the sandy and muddy seabed, thus changing the natural pattern and firmness of the bottom habitat. The turbidity of the water is increased. The numerous habitats of the numerous bottom dwelling organisms, such as worms and sea urchins are destroyed.

## 9. PERCEPTION OF THE PRESENT SITUATION REGARDING SHRIMP EXPLOITATION INCLUDING ENVIRONMENTAL IMPACTS

### 9.1 By artisanal fishermen

The artisanal fishermen have traditionally set gillnets on the trawl grounds and occasionally these are lost when fouled by the trawl gear. The Fisheries General Regulations of 1973 provide that the lost or damaged gears should be compensated, and that all gears be suitably marked to enhance visibility. Despite these requirements some gears continue to be lost, and thus artisanal fishermen regard shrimp trawling as detrimental to their fishing gear.

Fisher Communities along the coast considerthat shrimp trawling with discarding of large quantitites of fish is wasteful practice. The Communities are now reporting declining artisanal fish catch in fishing grounds where trawlers have operated.

### 9.2 By the Fisheries Authorities

The Fisheries Authorities observe that trawling requires close monitoring to ensure that there is no environmental degradation which could result in the alteration of marine ecology and hence in a reduction of marine resources with the possibility of generating social economic losses.

In addition, observing that the catch from the trawlers is close to the estimated MSY, the Authorities decided to limit the number of vessels to avoid over-investment as well as stock depletion.

## 10. THE SOCIAL IMPLICATIONS OF ADJUSTING FISHING TO MORE ENVIRONMENTALLY FRIENDLY PRACTICES

The shrimp trawls have increased the supply of fish for local consumption especially in Dar Es-Salaam and other regions close to it. Several young Tanzanians are working in the fishing vessels.

The Government's Policy in respect to the management of the fisheries gives priority to maintaining development, particularly with regard to the rural community.

The real strength of the prawn fishing industry on the coast of Tanzania lies in the multitude of small scale fishing communities scattered along the coast of the Indian Ocean. Artisanal fishermen are also engaged in agricultural activities. As a result they supply part of the country's fish production, as well as rice, coconut, cassava, etc. In terms of future developments, the National Fisheries Authorities consider that the artisanal sector, as a whole, has the potential to provide much more fish and prawn if small scale fishermen are provided with motorized boats or proper fishing craft and gear.

## 11. NATIONAL IDENTIFICATION OF PRIORITY ISSUES REQUIRING ACTIONS TO MEET ACCEPTABLE STANDARDS OF ENVIRONMENTALLY FRIENDLY SHRIMP EXPLOITATION

The National Fisheries Sector Policy and Strategy Statement addresses the problems of conservation, management and development of the fisheries resources.

There is still unsufficient consciousness of the potential value of the fisheries resources and, therefore, unsufficient attention to resources conservation and management of the fisheries.

However, the relevant National Statement focuses on the promotion of sustainable exploitation, utilization and marketing of fisheries resources to provide food, income, employment and foreign exchange earnings and effective protection of the aquatic environment to sustain development.

The Fisheries Policy encompasses the need for a change in attitude towards fisheries resources use practices as well as the necessity to manage, conserve and develop them for common prosperity.

To meet acceptable standards of environmentally friendly shrimp exploitation, the Fisheries Sector is facing a number of problems which require actions: including, among other:

- Insufficient information on the resource available
- Lack of capacity to carry out research
- Poor handling and inadequate processing methods and technologies
- Poor transport and distribution network leading to high levels of post-harvest losses
- Inadequate national capacities and infrastructure for training
- Environmental degradation and inability to integrate environmental protection with development
- Insufficient empowerment of the local communities
- Lack of discussion on issues and action from fisheries communities
- Unfavorable credit condition from money lending institutions

Besides, there are a number of constraints that limit the capacity of the fisheries sector to solve the problems.

They include:

- Lack of recognition of the value, on long-term, of the fisheries resources and its potential contribution to the economy
- Inadequate financial and technical resources
- Low level of technology among the artisanal fishing communities
- Inadequate support services, including for research and extension
- Lack of proper equipment for fishing, fish handling and transport facilities
- Lack of appreciation of the gender perspectives in the fisheries activities
- Unsufficient reliance of Donors for funding projects in the country
- Inability to fully exploit the National Exclusive Economic Zone (EEZ)

The subject of living marine resources and the potential negative impact of the shrimp trawling fisheries on the environment are areas of concerns for the Tanzania's fisheries sector. The fisheries sector therefore, calls for the following actions to address fisheries resources and aquatic environment protection:

- Integration of conservation and sustainable utilization of the fisheries into the socio-economic programmes for the Sector
- Encouragement and support of all initiatives leading to protection and sustainable use of the fish stocks and aquatic resources
- Protection of the productivity and of the biological diversity of coastal and aquatic ecosystems through prevention of habitat destruction, pollution and over exploitation

The strategies developed to address the fisheries resources and environment protection include:

- Control/ban destructive fishing and processing methods
- Monitor and review environmental protection measures applied in the fisheries sector
- Promote protection of the fragile ecosystem, ecosystem processes and conservation of bio diversity.
- Protect endangered and threatened aquatic species throughout their life
- Protect vulnerable species, habitats and areas of special ecological significance through accordance of special status to such areas e.g. marine parks, marine reserves and closed breading areas
- Adopt relevant regional and international protocols and treaties for protection and conservation of the fisheries resources and aquatic environment.

## 12. PROPOSAL FOR A PLAN OF ACTION FOR DEVELOPMENT OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES FOR SHRIMP EXPLOITATION. A STUDY TO EVALUATE THE IMPACT OF THE NATIONAL FISHERIES POLICY ON THE MANAGEMENT OF THE COASTAL PRAWN RESOURCES

The knowledge, perception and attitudes of the stakeholders in the fishing industry, towards the national fisheries policy are not known. It is imperative that the people's knowledge be tapped as a basis for decision making.

**Long-term objective of the study**

To formulate strategies which will enable the exploitation of the marine resources in an environmentally friendly manner to the benefit of the coastal communities and the country, in general.

**Short term Objectives**

1. Assess the impact of the current fisheries policy on the management and development of prawn fisheries by artisanal and industrial fishermen.

2. Evaluate the attitude of stakeholders (fishermen, fish traders, processors, local and central government officials) regarding prawn resources and their exploitation.

3. Determine the impact of artisanal and industrial fisheries activities on the environment in and near fishing grounds.

4. Improve the technical and economic efficiency of the fishing, processing and marketing sectors of the prawn fishery in order to raise incomes of coastal community households.

5. Increase opportunities of employment for coastal communities in the fishing, processing and marketing sectors of the prawn fishery.

6. Increase, in particular, opportunities of employment for coastal women and youth.

7. Facilitate the access of small scale (artisanal) fishing, processing and marketing sectors to necessary supply through the provision of credit.

8. Suggest improvement of extension services to small scale (artisanal) fishing, processing and marketing sectors through the provision of technical assistance.

9. Determine and recommend policy strategies for improving the social and economic welfare of artisanal fishermen and their communities.

The programme and relevant Plan of Action concerning a reduction of the impact of the shrimp fisheries will benefit to a wide range of stakeholders including Artisanal fisheries, Fisheries Authorities, fishing communities, in particular, women and rural unemployed youth, boats owners, other local and foreign investors on the prawn fishing industry and other related activities like boat building, making of ice containers and ice blocks.

Other local on the coast of Tanzania. Owners of the Commercial prawn trawlers.

It is expected that the main components of the Plan of Action will include, in particular:

- To publicize and make the Fisheries Policy known to all stakeholders in the prawn fishing industry.
- Training in the construction of By-catch Reduction Devices in the National Fisheries Training Institutes.
- Tests and demonstration of the use of By-Catch-Reduction Devices to Prawn Trawler Operators.

# LATIN AMERICA

## COLOMBIA

**ANÁLISIS BIOLÓGICO PESQUERO Y ECONÓMICO DE LA FAUNA ACOMPAÑANTE EN LA PESQUERÍA DE ARRASTRE INDUSTRIAL COLOMBIANA; Contribución Biológica y Económica para la Investigación y el Desarrollo en Recursos Pesqueros Colombianos y Estimación del Impacto de la Fauna Incidental en la Pesca de Arrastre del Camarón**

Por: Carlos G. Barreto Reyes; Coordinador nacional para Colombia; Gustavo A. Polo Romero (Economista) y Beatriz Mancilla Páramo (Biólogo Marino). Con la colaboración de: Magda Pineda (Biólogo); Félix Cuello (Ingeniero Pesquero) y Armadores; Santa Fe de Bogotá

## Abstract

### Pacific side

In 1996, the shrimp catch was 4 139 t (twice as much as in 1992). Western white shrimp and white leg shrimp are the main species. However, a shift of the fishing effort to other species such as Pacific seabob and carabali shrimp is now observed and recent progress in technology has lead to diversification of the fishing effort toward deeper shrimp species. The situation regarding by-catch and discard is not known. In 1998 there were 115 vessels, a high majority of which were small boats operating in coastal areas.

### Atlantic side

In 1996, the shrimp catch was 916 t, with a regular decrease since 1992. Pink shrimp and redspotted shrimp predominate. It is estimated that 4 kg of bycatch is discarded for 1 kg of shrimp caught. The shrimp fishing fleet consists of large vessels (larger than on the Pacific coast).

Regarding the utilization of the catches, from both the Pacific and Atlantic coast, the large shrimps (certain species, in particular) are in general exported, smaller shrimp, fish, other crustaceans and molluscs are for the local market.

The concern is that shrimp resources on both the Pacific and Atlantic coasts are now over-exploited. Conflicts between artisanal and industrial fishermen are frequent.

## Resumen

### Zona del Pacífico

En 1996, las capturas de camarón alcanzaron 4.139 toneladas métricas (el doble de las capturas reportadas en 1992). Las principales especies capturadas fueron el camarón blanco del oeste y el camarón pata blanca. Sin embargo, actualmente se observa un cambio en el esfuerzo de pesca hacia otras especies como el "seabob" del Pacífico y el camarón carabalí, además, el reciente progreso en la tecnología ha permitido la diversificación del esfuerzo de pesca hacia especies de camarón de aguas profundas. Se desconoce la situación relativa a la fauna de acompañamiento y los descartes. En 1998 la flota estaba constituida por 115 embarcaciones, la mayoría de ellas pequeñas naves que operan en la costa.

### Zona del Atlántico

En 1996, la captura de camarón fue de 916 toneladas métricas, manteniendo el decrecimiento observado desde 1992. El camarón rosado y el camarón mancha roja, constituyen las especies predominantes. Se estima que 4 kilogramos de fauna de acompañamiento son descartados por cada kilogramo de camarón capturado. La flota pesquera camaronera está constituida por embarcaciones de gran tamaño (más grandes que las embarcaciones de la costa del Pacífico).

En cuanto a la utilización de las capturas, tanto de la costa del Pacífico como de la costa Atlántica, se evidencia que la mayor parte del camarón grande (particularmente algunas especies) se destina a la exportación, mientras que el camarón pequeño, el pescado, así como otros crustáceos y moluscos se destinan al mercado local.

La preocupación actual se centra en que los recursos camaroneros, tanto de las costas del Pacífico como del Atlántico, se encuentran sobre-explotados. La situación genera conflictos frecuentes entre pescadores artesanales e industriales.

## 1. INTRODUCCIÓN

Colombia, por su posición geográfica en América del Sur, posee el privilegio de tener dos costas, la costa sobre el océano Atlántico y/o costa Caribe y la costa sobre el océano Pacífico, donde se desarrolla una de las industrias pesqueras con mayor auge económico como es la del camarón, utilizado en un 85 % para las exportaciones colombianas.

Durante la pesca de arrastre del camarón se capturan, junto con este espécimen, gran cantidad de especies de peces, crustáceos, moluscos y otros organismos que ocupan espacios marinos en la columna de agua como los pelágicos, demersales y bentónicos.

Para poder conocer los efectos que atañen a la pesquería del camarón con otros individuos, que son objeto económico de otras pesquerías, es necesario conocer el comportamiento de esta pesquería de arrastre y la relación intrínseca que se presenta con especies que corresponden a la pesquería de "pesca blanca".

Estas especies adicionales a la pesquería de los camarones se pueden catalogar en dos grupos: el grupo de las que se comercializan y grupo de las que se descartan. El primer grupo consiste básicamente de peces con valor comercial, que actualmente representan ingresos económicos adicionales para el armador extractor de camarón, debido a la disminución del potencial pesquero de este recurso específico. El segundo grupo está compuesto por peces y otros crustáceos, con poco o ningún valor comercial, que son devueltos al mar casi en su totalidad.

A esta agrupación se le denomina "fauna acompañante", por otra parte, existe una exigua pesca artesanal que aprovecha en algo este recurso. Es importante aclarar que muchas de las especies que componen la denominada "ranfaña" o "morralla" son juveniles de especies comerciales, pero que no tienen valor económico por su tamaño, siendo subutilizadas a causa de un desconocimiento sobre las especies no tradicionales que podrían utilizarse como recurso aprovechable.

El documento que recoge y analiza parcialmente la situación de la pesquería de arrastre, condiciona la integración conceptual temática en cinco capítulos. El primero recoge la información parcial, desde el punto de vista biológico-pesquera, de las especies que forman el conjunto de la pesca denominada "Fauna Acompañante" que se relacionan con la pesquería de arrastre de camarón.

El segundo se relaciona con el enfoque económico, integrando para el análisis los resultados: pesqueros, inversiones, tecnología, costos y resultados financieros de la actividad pesquera, en las dos pesquerías de arrastre conocidas como de aguas someras y aguas profundas. Este capítulo tiene como base la información suministrada, como resultado de una faena realizada para la pesca en la costa del Pacífico colombiano.

El tercer capítulo, contiene los resultados de la pesquería de aguas someras en el litoral Atlántico, analizadas en igual contenido del capítulo segundo para la flota pesquera del Caribe colombiano.

El cuarto capítulo, hace referencia al contexto normativo con que se regula, administra el desarrollo de las pesquerías en Colombia.

El capítulo quinto desarrolla un análisis de las muestras hidrobiológicas, tomadas durante las faenas como investigación de campo, que identifican el contenido estomacal. Este tipo de análisis busca identificar el tipo de individuo y la localización temporo - espacial intervenida con las redes de arrastre.

Finalmente, el capítulo donde se dan algunas conclusiones y recomendaciones referentes a la interrelación de la pesquería de los individuos de la "pesca blanca" y la actividad arrastrera del camarón.

### Objetivos del trabajo

Evaluar el estado de la captura incidental, como producto de la pesca de camarón, con el fin de tomar las medidas de ordenamiento necesarias para su protección.

Objetivo Económico

Se busca conocer el comportamiento de la relación pesquera y económica en la operatividad actual de las motonaves, frente al recurso objeto de la pesquería de arrastre y el uso que se hace de la fauna acompañante en la pesquería de arrastre del camarón, evaluando en su conjunto el concepto de inversión económica.

Objetivo Biológico Pesquero

Con la información obtenida de los cruceros de prospección pesquera se realiza el análisis del estado actual de las pesquerías, utilizando las herramientas biológicas y estadísticas que permitan hacer un diagnóstico puntual.

**Metodología económica**

1. Para cumplir los objetivos económicos y de acuerdo a los permisos de pesca otorgados para los barcos camaroneros, se cuantificó el número total y actual de las UEP's dedicadas a la extracción de los camarones en las dos costas colombianas. Para el estudio económico, éstas fueron clasificadas en intervalos estadísticos con la relación T.R.N. y el T.R.B. que sirve de parámetro metodológico para el análisis de la flota.

2. Dentro de esta población de UEP's se seleccionó una motonave al azar para generar la información requerida, de tipo económico-pesquera, que permitió inferir la caracterización de la nave seleccionada como modelo hacia el total de las motonaves que componen el respectivo intervalo, de la motonave seleccionada.

3. Para compilar la información, se diseñó un tipo de formulario que recopilaría los datos pesqueros y económicos proporcionados por los armadores pesqueros.

4. Este formulario se aplicó para cada faena de pesca a la motonave seleccionada, en forma tal que los datos recopilados y analizados corresponden a resultados independientes a cada faena en su relación con la fauna acompañante y el producto objeto de captura de la pesquería.

5. Se estructuró la información de las inversiones en la pesquería de arrastre, cuantificándolas y sometiéndolas a evaluación económica.

6. Se diseñó la estructura de costos e ingresos para la respectiva faena, en función de los productos alcanzados y clasificados.

7. Se realizó la evaluación económica de la información, en contexto integrado del conjunto de datos, mediante el método por diferencia de VPN y se corroboró con la función TIR del programa de Excel para el supuesto de 8 meses.

**Metodología biológica y pesquera**

Para recolectar la información biológica se planearon seis cruceros, tres en el Atlántico y tres en el Pacífico. La investigación se llevó a cabo en las motonaves que realizan faenas de pesca comercial. Para la toma de información se diseñaron dos tipos de formularios, uno que permitió recopilar datos relacionados con el lugar de pesca, condiciones ambientales y capturas de cada uno de los diferentes recursos. El otro se utilizó para recolectar los datos de tallas de las especies más sobresalientes en cada una de los lances.

Luego de depositar la captura en cubierta, se procedió a efectuar una estimación del peso de la misma. Se tomó una muestra y se realizó el siguiente trabajo: se pesó el total de la muestra, se identificó por especie y a las más abundantes se les efectuó una morfometría (tallas). Se extrajeron los estómagos de algunos ejemplares y se conservaron en una mezcla de formol y glicerina para posteriormente ser analizados en tierra.

El trabajo en tierra consistió en almacenar la información, en hojas de calculo Excel y base de datos Access. Las muestras de estómagos se abrieron, se extrajo su contenido y se anotó si el mismo estaba

vacío, si tenía restos orgánicos en digestión o presas enteras. Se identificó, hasta donde fue posible, cada una de las presas.

Los datos almacenados fueron analizados teniendo en cuenta la distribución de frecuencias, el lugar de la captura, la hora y la fecha. Así mismo, se hizo una distribución de frecuencia de las tallas y se tabularon las capturas por especies. Finalmente, se hizo un análisis de varianza para comparar las influencias de los anteriores parámetros con respecto a la captura.

## 2. ÁREA PESQUERA DEL PACÍFICO COLOMBIANO

Es conveniente conocer, en términos generales, algunos antecedentes de las pesquerías específicas, con otros recursos marinos que se convierten en productos adicionales de la pesquería del camarón; productos que ocupan una posición dentro del cuerpo de las aguas marinas denominados en su conjunto como pelágicos y demersales, y que, de acuerdo a los sistemas de captura utilizados por la pesca del camarón, intervienen directamente a otras poblaciones (productos) que corresponden al uso y aprovechamiento de otras pesquerías adyacentes a la de los camarones.

### 2.1 ÁREA DE PESCA EN LA COSTA DEL PACÍFICO COLOMBIANO

La costa Pacífica tiene una extensión de 1.392 kilómetros. Comprendidos entre los sitios que marca la frontera con Panamá a 77° 53' O; 7° 12' N, y la desembocadura del río Mataje 78° 45' O; 1° 20' N, en la frontera con el Ecuador.

La costa Pacífica presenta una topografía bastante accidentada. La geomorfología del litoral se divide en dos grandes zonas, la primera comprendida entre el norte de cabo Corrientes y límites con Panamá; ésta presenta acantilados y es dominada en gran parte por las estribaciones de la serranía del Baudó. Hacia el sur de cabo Corrientes, se extiende una llanura rellena parcialmente por sedimentos marinos y salobres del terciario que determinan que la costa sea baja, con playas arenosas y extensas formaciones de manglares donde existen diversas áreas estuarinas formadas por las desembocaduras de los ríos, hasta la frontera con el Ecuador (Días, *et al.*, 1998).

Esta costa, presenta en su totalidad una plataforma costera de 5.602 $mn^2$, en general estrecha al norte de cabo Corrientes; la parte más ancha, de alrededor de 25 millas en una identación rectilínea, incluye la bahía de Buenaventura en su extremo noroeste, y se extiende desde el golfo de Tortugas hasta el sur de la isla Gorgona, o sea, en una longitud de cerca de 90 millas. Esta área de la plataforma al norte de Buenaventura tiene aproximadamente 70 millas de longitud y 10 millas de anchura y se extiende entre cabo Corrientes y Punta Charambirá.

Presenta extensiones insulares como la isla continental Gorgona, Tumaco, El Morro, Viciosa y Cascajal y la isla oceánica de Malpelo, a una distancia de 240 millas de Buenaventura.

En cuanto a la Ensenada de Tumaco, considerada zona especial de pesca de camarón, se localiza en el sector sur del litoral Pacífico entre las latitudes 1° 45' – 2° 00' N y las longitudes 78° 30'- 78° 45' W. Su área aproximada es de 350 kilómetros cuadrados con profundidades entre 2 a 30 metros.

Sus aguas tienen menor productividad que las aguas templadas frías. De tal manera, que las especies animales que se encuentran en las aguas tropicales presentan mayor diversidad que en las aguas templadas frías, pero tienen un pequeño número de individuos por superficie, cuando se trata de especies de fondo, o por volumen de agua cuando se trata de especies pelágicas. Además, su ciclo de vida, más rápido, determina que las especies tropicales queden aptas para la reproducción con tallas generalmente más pequeñas, que las especies de aguas templadas.

Es diferente la situación que se presenta en relación con las especies de superficie. Las especies costeras encuentran en las aguas tropicales condiciones locales favorables, sea por la existencia de un afloramiento o por el aporte de sales disueltas asimilables de origen continental, transportadas por los ríos. Sin embargo, la importancia de su explotación deberá ser definida antes de considerarse la posibilidad de grandes capturas por medios modernos de alta productividad.

En lo que a peces de superficie se refiere, su "hábitat" está normalmente situado más allá de la plataforma continental, lo que hace que sean generalmente poco conocidos o casi ignorados por los pescadores.

En lo que a la plataforma submarina se refiere, es estrecha e irregular. Los peces de fondo no son tan abundantes como en los mares templados, pues además de la pequeña productividad, la irregularidad del fondo determina una captura técnicamente difícil y muchas veces imposible, con las artes modernas.

La zona con mayor frecuencia de pesca corresponde a la zona sur del Pacífico, donde según Angulo (1995) se estima que se realizan 42 lances en la zona sur, contra 16 en las zonas norte, 24 en la zona centro norte y 16 en la zona centro sur.

## 2.2 PESQUERÍA DE ARRASTRE EN AGUAS SOMERAS DE LA COSTA PACÍFICA Y LAS ESPECIES PELÁGICO COSTERAS

La actividad de la pesquería de camarón de aguas someras en el Pacífico, se realiza a lo largo de la costa. Hasta las 3 primeras millas náuticas se consideran de aprovechamiento exclusivamente artesanal, después de las 5 millas náuticas de la línea costera, corresponde el ejercicio a la industria arrastrera del camarón.

A partir de esta distancia, la pesquería industrial se desarrolla a profundidades de 20 a 40 brazas de profundidad, mediante el método de pesca con redes de arrastre. Este arte pesquero ocupa diferentes niveles en la columna de agua y su forma abierta y dinámica de operación, le permite intervenir diferentes especies de peces, crustáceos, moluscos y otras especies que ocupan diferentes espacios marinos y que son intervenidos por las redes de arrastre.

En el Pacífico colombiano existen dos tipos de fauna acompañante, la primera corresponde a la proporcionada por la pesca de camarón de aguas someras (*Penaeus occidentalis*; *P. stylirostris; P. vannamei; Trachypenaus Birdi; T. faoea y P. xiphopenaeus riveti*) y la segunda, a la proporcionada por la captura de camarón de aguas profundas (*Penaeus californiensis; P. brevirostris; Solenocera agassizii y Heterocarpus sp* ).

Dadas las circunstancias operacionales del sistema de producción de pesca, para la explotación de los camarones, que involucran otros recursos pesqueros que por su ubicación temporo-espacial se adicionan a la pesquería del camarón, observaremos las características de algunas especies de peces que forman la mayor captura incidental de esta pesquería.

En la zona de las especies pelágico costeras del Pacífico colombiano, los peces que se pueden destacar son la plumuda - sardina (*Opisthonema libertate, O. medirrastre, O. bulleri* ) que se concentra principalmente en las proximidades de la frontera ecuatoriana e igualmente son capturados por barcos camaroneros al sur de Buenaventura, pero en pequeñas cantidades y mezclada con otros clupeidos, principalmente carduma.

En 1978, el Inderena estimó el potencial de la plumuda en 35.000 toneladas año. El programa INPA-VECEP en 1997, identifica a la plumuda como una de las especies de mayor importancia, con una biomasa instantánea de 8.480 toneladas y con un rendimiento máximo sostenible de 15.000 toneladas, y considerándolo como un recurso subutilizado, ya que hasta el momento no existe esfuerzo pesquero alguno sobre este recurso (Castillo *et al.*, 1992).

Ante esta situación y como alternativa, se ha planteado la necesidad de brindarle a la industria la posibilidad de diversificar su pesquería hacia la plumuda, el cual se considera el segundo recurso en importancia y que de una u otra forma le daría una tregua al recurso carduma para que éste mantenga su explotación en niveles de sostenibilidad (Ricci, 1997).

La carduma (*Cetengraulis mysticetus*), se distribuye en aguas someras muy cercanas a la costa, estimándose un potencial de 10.000 toneladas año (1978). Dadas sus características costeras, es una especie importante para la pesca artesanal. Se estima con una biomasa instantánea de 17.440 toneladas (Castillo *et al.*, 1992), con un rendimiento máximo sostenible de 25.000 toneladas. La explotación de

esta especie se encuentra en un nivel alto, lo que ha llevado a la industria a solicitar el aumento de captura.

En cruceros de evaluación de plumuda y de carduma, se capturan otras especies generando una captura productiva así: carduma con el 45,11 %; plumuda con el 28,41 %; berrugate con el 15,98 %; ñato con el 4,84 % y ojón con el 2,42 %.

Tanto la carduma como la plumuda, son utilizados para la elaboración de harina de pescado, que a su vez es utilizada en la preparación de alimentos concentrados y en menor grado en la elaboración de enlatados (a base de plumuda). En general se puede decir, que el recurso plumuda está asociado a temperaturas altas y la carduma a temperaturas medias y altas. Estos dos recursos están asociados a salinidades bajas y medias.

La sierra se distribuye a lo largo de la costa. Se estima un potencial de 541 toneladas año (Inderena, 1978).

Las estimaciones de biomasa para las cinco principales especies, que presentaron mayor volumen de captura fueron la *Mustelus lunulatus* (toyo vieja) con una densidad media de 1,20 t/mn$^2$ con una biomasa media de 3.181 toneladas. Esta especie se hace presente en los niveles de profundidad media y somera ( Zapata *et al.*, 1995).

Para el *Diapterus peruvianus* (palometa) presentó una densidad media de 2,72 t /mn$^2$ con una biomasa media de 2.176 toneladas. Se hace presente en niveles de profundidad somero y medio.

El *Squatina californica* (angelote) con una densidad de media de 1,6 t/mn$^2$ con una biomasa media de 2.412 toneladas. Se hace presente sobre niveles de profundidad somero, medio y profundo.

El *Lutjanus guttatus* (pargo lunarejo) presentó una densidad media de 1,43 t/mn$^2$ con una biomasa media de 1.168 toneladas. Se hace presente sólo en niveles de profundidad somero.

Para el *Centristhmus signifer* (pargo nylon) presentó una densidad media de 0,69 t /mn$^2$ con una biomasa media de 1.470 toneladas. Esta especie se hace presente en todos los niveles de profundidad.

El lutjanus colorado presentó una densidad media de 1,02 t/mn$^2$ con una biomasa media de 2.085 toneladas. Se presenta en niveles de profundidad somero y medio, con mayor presencia en el nivel medio.

## 2.3 PESQUERÍAS DE ARRASTRE DEL PACÍFICO EN AGUAS SOMERAS Y PROFUNDAS CON LAS ESPECIES DEMERSALES

Para la pesquería del camarón de aguas someras y profundas se han establecido espacios marinos diferenciales, que en un momento dado interactúan operativamente con productos pertenecientes a los dos espacios temporo-espaciales, desde luego incidiendo en la captura incidental de especies pelágicas y demersales.

En investigaciones realizadas por el INPA, para el camarón de aguas profundas, se han considerado estratos por profundidades de 20 a 40 brazas (aguas someras), de 40 a 70 brazas, de 70 a 100 brazas y de 100 brazas en adelante (Angulo, 1995). Es decir, que a estas profundidades estaríamos hablando de pesca de arrastre para el camarón de aguas profundas. Sin embargo, algunos camaroneros de las aguas someras han reportado captura de camarón de profundidad (Polo *et al.*, 1990) pero que carecen de representatividad económico-productiva frente al objetivo de la pesca de camarones de aguas someras.

En la pesca del camarón blanco langostino (*P. occidentalis*), cuyo espacio de captura se ubica en las aguas someras, aparece también el camarón pink (*P. brevirostris*) cuyo hábitat corresponde a una pesca de más de cuarenta brazas, y cuyo espacio temporal les ha identificado como especie de aguas medias y profundas. Este espécimen aporta el 16,9 % en la producción total del camarón del Pacífico colombiano en aguas someras. También aparecen otros camarones como el pink, el café que forman el 3,1 % de esta misma producción, caracterizados como individuos que pertenecen a la pesquería de aguas profundas, pero por la poca cantidad capturada pasan a ser especies incidentales de la pesquería de camarón en las aguas someras.

En cuanto al pescado blanco capturado por redes de arrastre, estos corresponden a peces de sistema rocoso (pargos, chinos, meros, entre otros). Se distribuyen en zonas aisladas de alguna productividad, denominados localmente riscales. Su profundidad oscila entre 25 a 100 brazas. Los bancos de mayor explotación en el Pacífico son los de Gorgona y Malpelo. No hay datos precisos del potencial en dichas áreas (Inderena, 1978).

En cuanto a la pesca de camarón en aguas profundas, ésta presenta tres especies pink (*P. brevirostris*), coliflor (*S. agassizii*) y café (*P. californiensis*). En el año 1995 se desembarcaron 751,48 toneladas de camarón de profundidad, de las cuales el 47,16 % correspondió a *Penaeus brevirostris* y el 52,84 % a *S. agassizi.* Se observa que el desembarque del año 1995 presenta una disminución con respecto al año 1994 del 5 %, año éste, en que la captura se había incrementado en un 32,2 % frente al año 1993, lo que estuvo directamente relacionado con el aumento del esfuerzo en un 13 % (Madrid, 1997).

Durante èl año, la máxima CPUE para el pink se encontró en junio y la mínima en octubre y noviembre. Durante junio, las operaciones se ubicaron en la zona norte y la profundidad estuvo entre 70 – 100 brazas. En abril, que también presentó una CPUE considerable, la zona de pesca fue el Norte a profundidades entre 70 - 100 brazas. En octubre y noviembre se ubicó en la parte centro y norte de la costa, con profundidades por encima de las 100 brazas (Madrid, 1997).

Con respecto al coliflor, su mayor CPUE estuvo en julio-agosto a profundidades entre las 10-150 brazas, la zona de pesca fue el Norte. Cuando se presenta baja CPUE de esta especie no se debe a baja abundancia del recurso, esto se debe a que el objetivo de pesca es otro recurso (Madrid, 1997).

En general, la mayor CPUE en cuanto a zonas de pesca para el pink y coliflor se obtuvo en la zona norte, específicamente las localidades de cabo Corrientes y Arusí; para el café la mejor área de pesca correspondió a la zona centro.

Otras investigaciones realizadas por el INPA, con respecto a la fauna acompañante del camarón de aguas profundas a diferentes profundidades, han mostrando que la captura de los camarones, tanto en aguas someras como profundas y por el método de arrastre utilizado, siempre estará ligada a las especies de peces en las dos áreas de pesca de los productos camaroneros.

Se calcula que la captura de estos peces incidentales, obtenida de la flota camaronera del Pacífico, podría alcanzar 52.000 toneladas año, de las cuales 13.500 tendrían valor comercial (Inderena, 1978). Es decir, que el 74 % de la fauna sin valor comercial corresponde a especies que forman parte de una cadena trófica con valor económico ambiental.

## 2.4 LA PESCA DE ARRASTRE Y LA ESTRUCTURA BIOLÓGICA PESQUERA DE LAS ESPECIES DE PESCA BLANCA

Como se vio en los párrafos anteriores, los peces pelágicos y demersales se encuentran a diferentes niveles de profundidad, lo cual hace pensar que tanto la pesquería de arrastre del camarón de aguas someras como de profundas, tienen la tendencia a capturar peces de diferente localización espacio-temporal marino.

En la pesca blanca se identifican cinco familias en el Pacífico colombiano ( Zapata *et al.*, 1997).

a) En la familia de los tiburones Carcharhinidae y Sphymidae; predomina con mayor representación los toyos o quilludos *Carcharhinus falciformis* y la cachuda, *Spphyrna lewini*. Estos se presentan en dos períodos caracterizados por la alta abundancia de alimento en el medio y la cercanía a la costa. El primero se captura entre los meses de mayo y junio, y el segundo entre septiembre y noviembre, período de mayor presencia de crías. Se capturan mediante redes de deriva, llamadas malladores de las siguientes características ojo de malla de 11 pulgadas de aproximadamente 4.000 metros de longitud y 15 metros de altura.

b) Para la familia Serranidae las principales especies son la cherna café (*Epinephelus cifuentesi*), la especie más importante para el sector de la pesca industrial, y el colorado (*Epinephelus acanthistius*) la especie más importante para la pesca artesanal. La cherna café se captura en bancos de Tumaco, Colombia, Pasacaballos, Naya y Pizarro, en profundidades que van de 90 a 450

metros sobre sustrato rocoso y el colorado en Charambirá, Juradó y Mallorquín, en profundidades superiores a los 45 metros.

c) En la familia Coryphaenidae se han reportado dos especies de dorado, *Coryphaena hippururs* y *C. equixelis*. La más importante es la primera. Para su captura se emplean redes de enmalle en las embarcaciones tiburoneras, como también líneas de anzuelos o palangres en la flota chernera. Su presencia en la zona puede considerarse estacional, sobre todo a comienzos del año. Su época de desove ocurre a comienzos del año, entre enero y abril.

d) La familia Lutjanidae que corresponde a los pargos. Este recurso presenta oscilaciones en las capturas, siendo consecuencia de una aparición estacional.

e) La familia Ophidiidae, hallándose a la merluza (*Brotula clarlkae*) como la especie más importante, por encima de *B. orwayi* que se presenta en muy baja proporción. También conocida como "corvina de altura". Es capturada en el ámbito artesanal mediante el uso del espinel e industrialmente por la flota camaronera de aguas profundas y laineros semi-industriales e industriales de la zona. Esta especie habita suelos arenofangosos y rocosos (bancos de Naya y Pasacaballos) en profundidades que van entre los 20 y 250 metros.

Dentro de las consideraciones alcanzadas para algunas especies de pesca blanca se puede mencionar que la flota pesquera de cherna a presentado una parálisis que ha favorecido a esta especie y a la merluza, por la disminución del esfuerzo pesquero. Sin embargo, al presentarse un intenso esfuerzo pesquero, se evidencia una rápida reducción en la talla media de captura (Angulo, 1995).

Respecto al dorado, se presentan capturas de individuos que ya han llegado a su primera madurez sin afectar los procesos de reproducción y reclutamiento. En cuanto a los tiburones el problema es más complejo, debido a que la talla media de captura que se reporta anualmente ha sido menor a la talla de la primera madurez, adherido al bajo número de crías y de crecimiento lento.

En recientes cruceros realizados por el programa INPA- VECEP-CE (1995-1997) para conocer sus potencialidades entre cabo Corrientes y cabo Manglares mostraron a los jureles, sierras, pargos y meros como los principales recursos pelágicos y demersales en esta zona. Otro crucero realizado entre bahía Málaga y la frontera con el Ecuador mostró a los espejuelos *(Selene spp)* y al tiburón toyo vieja (*Mustelus spp*) como los principales recursos encontrados.

Entre 1996 y 1998, el programa observó que se ha venido dando un desarrollo de la pesquería demersal, realizada con el arte denominado "long-line", dirigido especialmente a chernas y meros con objetivo de exportación. Se destacan también las capturas efectuadas sobre tiburones y en menor medida merluzas y pargos.

## 2.5 DISTRIBUCIÓN BIOGEOGRÁFICA DE LA FAUNA ACOMPAÑANTE RELACIONADA CON LA PESCA DE ARRASTRE

La distribución biogeográfica de las especies de peces, es un elemento esencial para determinar áreas compartidas con presencia de especímenes que forman pesquerías multiespecíficas influenciadas por la flota camaronera con ictiofauna que ocupa niveles espaciales dentro de la captura del camarón y la formación de la captura de peces como fauna acompañante.

Dentro de los cruceros del programa INPA-VECEP, se establece un nuevo sitio de distribución de la plumuda a los 2° 40' N – 78° 07" W que corresponde a la entrada a la población de Bazán e inicios del Parque Sanquianga (Ricci, 1997).

En la zona norte, donde generalmente se captura la plumuda, no se observó ningún cardumen durante el recorrido, a pesar de ser un sector de distribución del recurso. Tampoco se observaron manchas en la Ensenada de Tumaco. Las mayores capturas se presentaron en el sector de Punta Chavica, para la carduma y la plumuda, y el golfo de Tortugas para la carduma.

Hacia la parte norte del puerto de Buenaventura, se encuentran más lugares para la captura de camarones de aguas profundas, esto ha hecho que los capitanes prefieran el desplazamiento hacia esta parte de la costa. El camarón escasea hacia la parte sur del puerto, sin embargo, algunos armadores

hacen uso del sur cuando se puede encontrar una igualdad probable de captura de camarón. La profundidad detectada por abundancia de estos camarones está determinada por encima de las 40 brazas en adelante.

## 3. ACTUALES ALTERNATIVAS DE INVERSIÓN ECONÓMICA EN LA PESQUERÍA DE ARRASTRE EN EL PACÍFICO COLOMBIANO

En la captura de los productos pesqueros intervienen personas, equipos, redes, materias primas y otros aspectos que forman el conjunto de los elementos típicos para el proceso de obtención y conservación a bordo de los productos pesqueros, identificando una eficiencia técnica sobre los diferentes modos de producción que se presentan en la pesquería, dando como resultado la viabilidad tecnológica.

Para que se cumpla el proceso productivo anterior en el uso y aprovechamiento de los recursos pesqueros, estos se transforman en unidades monetarias, que se orientan sobre el conocimiento de la viabilidad económica para este tipo de inversiones.

### 3.1 LA FLOTA DE ARRASTRE DE LAS AGUAS SOMERAS EN EL PACÍFICO COLOMBIANO

El Puerto de Buenaventura es el centro de actividad de la mayoría de las motonaves dedicadas a la extracción del camarón, de aguas someras y profundas. Estas motonaves efectúan faenas lo largo de la costa Pacífica entre cabo Corrientes y Pasacaballos y un número pequeño de la flota tiene como sede el Puerto de Tumaco.

En 1990, existían 104 motonaves en la pesquería del camarón de aguas someras para el Pacífico colombiano (Polo *et al.*, 1990); para 1999 se reportan 75 embarcaciones, presentando una disminución del esfuerzo en este período de 27,9%.

Esta disminución del esfuerzo se logra por defensa natural del mismo recurso, cuyos efectos económicos de la pesquería en decadencia obliga a algunos armadores a retirarse de esta pesquería. Como consecuencia, unos armadores se trasladan a la pesquería del atún y otros a la pesca blanca, dependiendo de los costos de inversión para la reforma estructural y adaptación de las embarcaciones a la nueva pesquería.

Dentro del análisis que caracteriza la flota pesquera del camarón de las aguas someras, para 1999, de las 75 embarcaciones inscritas en esta pesquería, el 96,0 % son de bandera colombiana y el 4,0 % de bandera panameña. A pesar de que la flota esta compuesta por 75 motonaves, el 82,7 % son embarcaciones activas, el 9,0 % permanecen inactivas y se presentan motonaves que tienen permiso de pesca para extraer camarón de aguas someras y aguas profundas, conocidas como pesca mixta, representadas por el 8,0 %.

Para la clasificación y el estudio de la flota en esta pesquería se empleó el método de distribución de la flota realizado en 1990, cuyo análisis toma como base técnica el concepto del tonelaje de registro neto (TRN).

Para la caracterización y la clasificación de la flota (Tabla 1) se distribuye por intervalos relacionados con el TRN donde se muestran 5 grupos. El primero compuesto por 11 motonaves (14,7 %), el segundo con 42 motonaves ( 56,0 %), el tercer grupo representado por 14 motonaves (18,7 %), un cuarto grupo con 3 barcos (4,0 %) y el quinto grupo con 5 embarcaciones (6,7 %). Es decir, actualmente la tendencia a las inversiones en motonaves de camarones para aguas someras se concentra por debajo de las 47,3 toneladas del TRN, que corresponden a embarcaciones medianas y pequeñas, formando el 89,3% y menos de la flota.

La pesca de arrastre, para el camarón de aguas someras en el área de Tumaco, está determinada por 3 motonaves, 2 de las cuales pescan regularmente (Portilla, 1999); éstas manejan diferentes estrategias de pesca de acuerdo a la potencia de la máquina y los artes utilizados, por lo tanto, la eficiencia está determinada por estas variables. La profundidad a la que pueden pescar alcanza hasta las 22,2 brazas y, por lo general, las faenas se realizan a profundidades de 6,6 a 8,3 brazas, pesca que va dirigida al camarón blanco y titi de características de aguas someras.

**TABLA 1. Clasificación técnico-económica de las motonaves de arrastre para aguas someras, según el TRN y el TRB**

| INTERVALO TRN (toneladas) | COMPOSICIÓN No. de motonaves | TRN Medio (toneladas) | TRB Medio (toneladas) | Coeficiente Técnico Medio |
|---|---|---|---|---|
| 10,0 – 20 | 11 | 15,06 | 44,35 | 0,34 |
| 20,1 – 40 | 42 | 31,13 | 61,67 | 0,50 |
| 40,1 – 60 | 14 | 47,30 | 95,30 | 0,50 |
| 60,1 – 80 | 3 | 59,47 | 86,68 | 0,69 |
| 80,1 – 100 | 5 | 87,84 | 130,5 | 0,67 |
| TOTAL | 75 | 48,16 | 83,70 | 0,57 |

La más alta concentración de motonaves se presenta en el segundo grupo, en el intervalo comprendido entre 20,1 a 40 toneladas del TRN, con el 56 % de toda la flota de la pesquería de camarón de aguas someras (Figura 1). Sin embargo, se puede decir que entre 1990 y 1999, este grupo de motonaves, consideradas medianas, se mantienen como elemento económicamente productivo en esta pesquería, cuyo coeficiente técnico 1/ es de 0,50.

Los dos primeros grupos forman la flota económicamente productiva, y comprenden el 70,7%. Luego sigue el grupo comprendido entre 40,1 a 60 toneladas de TRN con una representación del 18,7%, que también presenta un coeficiente técnico de 0,50. En 1990, este grupo de embarcaciones estuvo formado por 31 motonaves, actualmente está conformado por 14 unidades económicas de pesca, bajando su representatividad en la pesquería del camarón de aguas someras en el 51,5 %.

En 1990, los grupos superiores a las 60,1 toneladas de TRN estuvieron compuestos por 11 motonaves, en 1999, solamente se mantienen 8 embarcaciones, disminuyendo en el período comparado en un 27,3%.

En la pesquería del camarón de aguas someras, en el Pacífico colombiano, el esfuerzo de pesca ha venido disminuyendo en forma acentuada, proporcionado por los efectos económicos que ha generado la disminución del recurso principal objeto de explotación.

Considerando la disminución física de la flota arrastrera, se puede decir que ha ocurrido una disminución en la captura de las poblaciones que componen la fauna acompañante. Sin embargo, estos últimos especímenes han tomado importancia financiera para el armador, cambiado su concepto en el manejo y uso.

### 3.1.1 Otras características técnico-económicas de la flota de aguas someras

Siguiendo el patrón utilizado para clasificar la flota (TRN) y en términos generales se ha identificado que el 41,3% de las motonaves poseen casco de acero, el 50,7% lo tiene en hierro y el 8,0% en madera (Tabla 2).

Al observar la composición de los intervalos del grupo con casco de acero (31), se evidencia que el 64,6% lo componen las motonaves que forman el intervalo de 20,1 a 40 toneladas, mientras que el intervalo de 40,1 a 60 toneladas representa el 16.1%. Estos dos grupos forman el 80,7%, con tendencia a concentrarse por debajo de las 60 toneladas de TRN.

En el grupo de las embarcaciones con casco de hierro (38), el 57,9% lo componen las motonaves que forman el intervalo de 20.1 a 40 toneladas, mientras que el intervalo de 10 a 20 toneladas representa el 23,7%. Estos dos grupos forman el 81,6%, con tendencia a la utilización de tonelaje de registro neto por debajo de las 40 toneladas de TRN.

Las motonaves que componen el grupo de las embarcaciones con casco de madera (6), forman el intervalo de 20,1 a 40 toneladas, seguidas del intervalo de 10 a 20 toneladas, cuya tendencia es a la utilización de tonelaje de registro neto menor a las 40 toneladas de TRN.

---

1/ Coeficiente técnico: relación entre el TRN y el TRB.

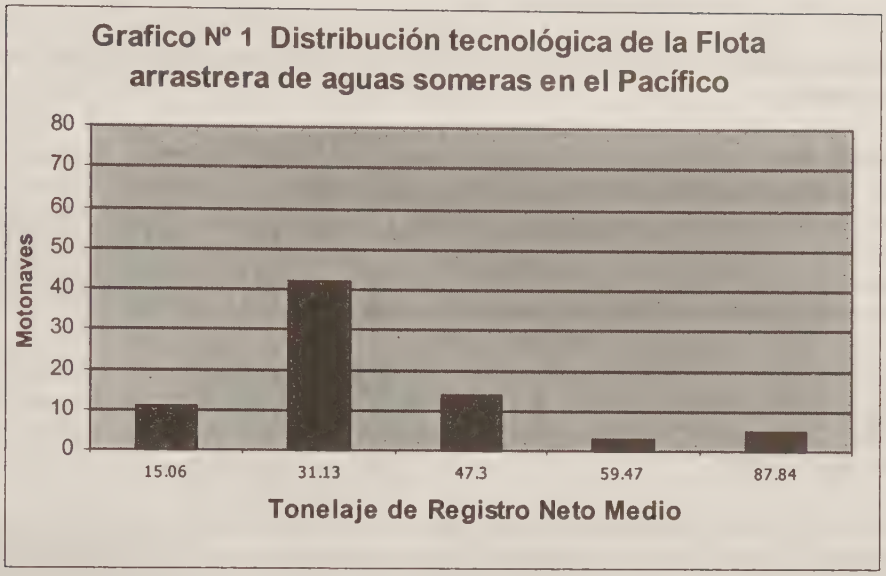



**TABLA 2. Caracterización técnico-económica de las motonaves de camarón de aguas someras. Según el casco y grupo clasificado con base en el TRN**

| INTERVALO TRN (toneladas) | TRN Medio (Toneladas) | CASCO ACERO | CASCO HIERRO | CASCO MADERA |
|---|---|---|---|---|
| 10,0 – 20 | 15,06 | 0 | 9 | 2 |
| 20,1 – 40 | 31,13 | 20 | 19 | 3 |
| 40,1 – 60 | 47,30 | 5 | 8 | 1 |
| 60,1 – 80 | 59,47 | 1 | 2 | 0 |
| 80,1 – 100 | 87,84 | 5 | 0 | 0 |
| TOTAL (%) | | 41,3 | 50,7 | 8,0 |

La tabla 3, presenta las dimensiones para la navegación de las embarcaciones según los intervalos caracterizados para su clasificación en estas motonaves.

**TABLA 3. Caracterización técnico-económica de las motonaves de camarón de aguas someras. Según dimensiones de navegación por grupo clasificado con base en el TRN**

| INTERVALO TRN (toneladas) | Motonaves No. | Eslora Promedio | Manga Promedio | Calado Promedio |
|---|---|---|---|---|
| 10,0 – 20 | 11 | 15,21 | 4,82 | 1,50 |
| 20,1 – 40 | 42 | 19,14 | 5,71 | 2,13 |
| 40,1 – 60 | 14 | 20,94 | 6,09 | 2,45 |
| 60,1 – 80 | 3 | 20,83 | 6,04 | 2,17 |
| 80,1 – 100 | 5 | 22,87 | 6,52 | 2,50 |

En cuanto a la potencia del motor, se observó que la capacidad del motor presenta una relación directa ascendente con el tonelaje de registro neto. Es decir, en el intervalo de 10 a 20 toneladas de TRN, corresponde a un motor de 257,3 H.P, para el intervalo de 20,1 a 40 toneladas el motor presenta una

capacidad de 285,24 H.P, para el intervalo de 40,1 a 60 toneladas, corresponde un motor de 318,6 H.P, en el intervalo de 60,1 a 80 toneladas de TRN el motor es de 337,67 H.P y finalmente el intervalo de 80,1 a 100 toneladas, poseen motores de 440,0 H.P.

## 3.2 CARACTERIZACIÓN ECONÓMICA DE LA FLOTA ARRASTRERA EN AGUAS SOMERAS

La composición de la flota de aguas someras no presenta un modelo específico de motonave para la producción de captura de camarón (Polo *et al.*, 1990), que garantice la eficiencia técnica y la eficiencia económica, condicionada paralelamente al manejo, aprovechamiento y existencias del recurso camaronero en el medio natural y menos a la captura incidental obtenida por el método de arrastre. Sin embargo, para 1999, la tendencia de las embarcaciones está pasando hacia motonaves de TRN menor, que generan mejor rentabilidad, como se identificó en 1990.

Sin embargo, se puede decir que, económicamente, la flota actual muestra una tendencia a disminuir inversiones en embarcaciones grandes y con coeficientes técnicos proporcionales al TRB, que corresponden a la formación de grupos de embarcaciones medianas y pequeñas, aspecto contrario al que se encontró en 1990.

De acuerdo con la variable establecida (TRN) para la clasificación de la flota pesquera de camarón de las aguas someras (Tabla 2), se identificaron dos tipos de motonaves que realmente extraían camarones de esta pesquería. Desde el punto de vista de inversión se considera a las motonaves pequeñas, las que ocupan el intervalo entre 10 a 40 toneladas de TRN, y las grandes consideradas en un intervalo de 40,1 a 100 toneladas de TRN.

En términos generales, las inversiones bastante subestimadas y dado el muestreo único que se realizó, la pesquería en motonaves pequeñas (53) tiene un valor total aproximado de 8,3 millones de dólares americanos 2/; en embarcaciones grandes (22) el valor estimado es de 6,6 millones de dólares americanos. Esto representa un total de 14,9 millones de dólares americanos invertidos en la pesquería del camarón de aguas someras; sector que debe generar rendimientos económicos proporcionales a la inversión y al riesgo.

Cuando el recurso principal, objeto de aprovechamiento, presenta disminución en sus poblaciones naturales, se presentan sobre-inversiones en la actividad pesquera, acarreando un lucro cesante. Esto lleva al armador a buscar mecanismos que complementen la captación productiva y de ingresos, y es cuando en las diferentes alternativas de captura y/o producción, hoy, encuentra una ayuda financiera con la fauna acompañante.

En 1990, la fauna incidental comenzaba a tener importancia para el armador -importancia no medida en esa época- pero mostrándose que las embarcaciones pequeñas eran las más adecuadas a las poblaciones de camarón, pues requerían capturar menos individuos para alcanzar el punto de equilibrio económico, mientras que las motonaves grandes (mayor TRN) requieren alcanzar un 30 % más de individuos para lograr su punto de equilibrio. Desde luego, la inversión unitaria en embarcaciones de más alto TRN, consideradas grandes, es mayor que en las pequeñas, y esto hace que se presente una inversión con lucro cesante y/o sobre-inversión pesquera.

A pesar de que esta actividad genera aproximadamente 5 empleos directos, el armador viene buscando alternativas de contratación con el fin de disminuir costos para poder lograr una rentabilidad adecuada a la magnitud de su inversión, pues según los armadores los efectos pesqueros (disminución del camarón, vedas, reducción de la talla, entre otros) no están dando los rendimientos adecuados. Por esto, muchos de los barcos estudiados en 1990 no son contabilizados para 1999 y se pudo observar que el comportamiento de deserción corresponde a las motonaves consideradas grandes por su respectivo TRN.

## 3.3 ANÁLISIS ECONÓMICO PARA LA MOTONAVE ARRASTRERA "DOÑA ROSARIO" DE AGUAS SOMERAS EN 1999

El concepto económico pesquero se forma de la interrelación entre actividad ambiental pesquera y actividad económica. La figura 2 esboza esquemáticamente la interacción del medio ambiente pesquero

---

2/ 1 dólar americano = 2.000 pesos colombianos

frente a la estructura económica cuando interactúan biológica, técnica y económicamente esta actividad (Polo, 1989).

Luego de examinar las características más sobresalientes de las fuerzas básicas, para la actividad pesquera se plantea ahora un aspecto fundamental de la motonave como unidad económica en su interés por obtener el máximo rendimiento económico.

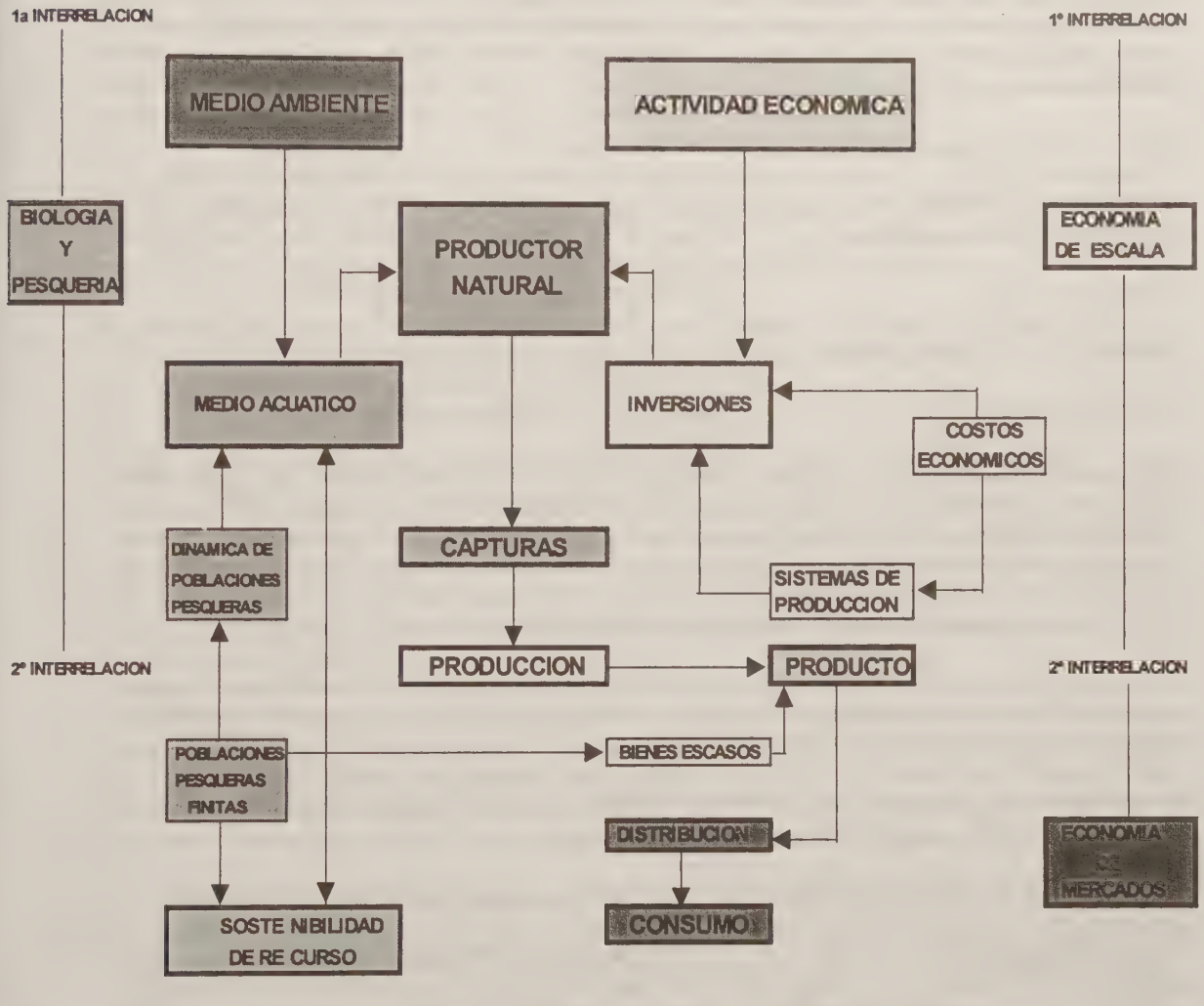



GRAFICO No 2.- INTERRELACION BIO-ECONOMICA PESQUERA FRENTE A LA ECONOMIA DE MERCADOS
FUENTE: POLO,Gustavo. "Fundamentos de mercadeo pesquero".Universidad Pedagógica y Tecnológica. Tunja.(Boyaca) 1989

La presente evaluación económica corresponde a una aproximación dada por la operación de la única faena que sirve como muestreo puntual para conocer a grandes rasgos el comportamiento de la pesquería con arrastreros de camarón en aguas someras y profundas, quienes involucran en este tipo de método de captura a la fauna íctica, poblaciones pertenecientes a otras pesquerías.

De acuerdo con registros tributarios del propietario, el valor – inversión - fija de esta embarcación equipada para 1999 es aproximadamente de 190.000 dólares americanos. Esta motonave tiene permiso de pesca, para operar en la pesquería arrastrera de camarones de aguas someras. La edad de esta embarcación es de 30 años, con un motor de 360 H. P.

Se caracteriza por poseer un tonelaje de registro bruto de 64,70 toneladas y un tonelaje de registro neto de 35 toneladas, con un coeficiente técnico de 0,54. Para el estudio, se identifica como embarcación perteneciente al intervalo 20,1 a 40 toneladas (tabla 2), infiriendo los resultados de un muestreo

realizado para esta motonave, a la composición de las embarcaciones que forman este grupo, representando el 56,0% de la flota con operación en aguas someras.

Los datos y análisis que se presentan a continuación corresponden a los resultados de una faena de pesca de 21 días duración, realizada del 3 al 23 de noviembre de 1999.

Debe tenerse en cuenta que una faena no es representativa para el estudio y análisis de un comportamiento económico adecuado como actividad empresarial. Por lo tanto, se sugiere una investigación más prolongada que permita medir los resultados durante un período mínimo de muestreo de 12 meses, complementando información interrelacionada como se expuso en el marco conceptual del párrafo anterior.

### 3.3.1 Inversión económica de la motonave "doña rosario"

Las inversiones estimadas para la operación de esta motonave en las aguas someras se pueden distribuir principalmente en dos conceptos:

| | | |
|---|---|---|
| INVERSIÓN FIJA: | 190.000,00 | DÓLARES AMERICANOS |
| CAPITAL DE TRABAJO-FAENA: | 4.821,20 | DÓLARES AMERICANOS |
| TOTAL INVERSIÓN: | 194.821,20 | DÓLARES AMERICANOS |

La inversión fija corresponde a una embarcación con todo el aditamento pesquero para operar en las aguas someras, en busca del camarón, principal producto del permiso otorgado por el INPA, y que por ejercicio de esta operación también se capturan productos pertenecientes a otras pesquerías, entre estos, los productos de la pesca blanca.

### 3.3.2 Rendimientos económicos de la producción de arrastre

El concepto de rendimiento está dado por el volumen del producto extraído del medio natural, tanto en productos de camarón como de los productos que componen la fauna incidental obtenida con el método con que se captura el producto principal objeto de la pesquería.

De acuerdo con la información compilada para la faena de estudio de la motonave Doña Rosario, la tabla 4 presenta los siguientes resultados físicos de producción:

**TABLA 4. Producción y rendimiento de la captura de arrastre y la fauna acompañante**

| Producto Pesquero | Producción (libras) | Participación (%) |
|---|---|---|
| **PECES** | | |
| Peces Grueso (grandes) | 3.480 | 50,2 |
| Peces Menudo (pequeños) | 270 | 3,9 |
| Alguacil | 34 | 0,5 |
| Lenguado | 396 | 5,7 |
| Sierrilla | 246 | 3,6 |
| Ñato | 464 | 6,7 |
| **Subtotal** | **4.890** | **70,6** |
| **CRUSTÁCEOS** | | |
| Camarón Tití | 860 | 12,4 |
| Camarón Coliflor | 268 | 3,9 |
| Camarón Blanco | 635 | 9,2 |
| **Subtotal** | **1.763** | **25,4** |
| **MOLUSCOS** | | |
| Calamar | 276 | 4,0 |
| **Subtotal** | **276** | **4,0** |
| **TOTAL FAUNA INCIDENTAL** | **5.166** | **74,6** |
| **TOTAL CAMARÓN** | **1.763** | **25,4** |
| **TOTAL PRODUCCIÓN** | **6.929** | **100,0** |

La tabla 4, presenta la producción obtenida de la captura en la faena de 21 días, donde se observa que el 74,6% de la producción de esta motonave corresponde a la denominada "fauna acompañante" y el 25,4% al producto camarón objeto de esta pesquería de arrastre.

Del total de la producción, se puede decir que el 70,6% corresponde a peces de especies pelágicas y demersales. Estas especies son comúnmente denominadas como "pescado grueso", que corresponde a la identificación de peces de talla comercial y contribuyen con el 50,2% del total de la producción, bastante representativa frente al producto objeto de esta pesquería, cuya composición íctica se estima en productos como: pargos, meros, chernas, jureles, toyos, corvinas, peladas, entre otros. El 20,4% está representado en lo que han llamado "pescado menudo" que corresponde a especies similares a las descritas para el "pescado grueso" pero de tallas inferiores a las comerciales, producto que su tendencia es pérdida para el medio natural y perdida en lo social.

En cuanto a los crustáceos, fueron reportados el camarón blanco, el coliflor y el titi que componen el 25,4% de la producción total y que son el objeto de esta pesquería. Donde el coliflor participa con el 3,9%, mínima participación pues esta especie se considera de aguas profundas pero que ha sido reportada como captura por la flota de aguas someras en similar participación (Polo *et al.*, 1990).

La anterior consideración muestra que la flota de aguas someras se desplaza a diferentes veriles de profundidad, interviniendo también las pesquerías de arrastre de aguas profundas y por ende la participación de peces pertenecientes a los demersales.

### 3.3.3 Estructura de costos para la operación y producción de la motonave arrastrera "Doña Rosario"

Los costos que muestra la tabla 4, corresponden a la información recogida de la faena de noviembre de 1999 para establecer la estructura de los costos. En esta tabla, los costos se han clasificado en variables y fijos relacionados directamente con la actividad pesquera, donde los costos variables son el 77,6% y los costos fijos forman el 22,4% de los costos totales.

Dentro de los costos variables se puede apreciar que los costos de combustibles y lubricantes, junto con los costos laborales, representan el mayor peso en la estructura formando el 69,4%. Dentro de estos dos tipos de costos, el armador viene tratando de manejarlos y por tal motivo busca replanteamiento sobre los salarios, buscando nuevas formas de contratación, acudiendo a la fauna acompañante para hacer parte de sus nuevos mecanismos de pago a la tripulación.

Según los armadores, el vínculo laboral ha ido cambiando a través del tiempo, inicialmente tenían sueldos fijos superiores al salario mínimo legal y con participación en la producción del camarón. Luego se pasó a un salario base por encima del salario mínimo con participación en la producción, exceptuando al del capitán, pero la baja producción del medio natural los ha llevado a la contratación por participación de la producción incluyendo la producción de la fauna acompañante.

La disminución de algunos costos, entre otros el de retirarle los seguros a la motonave, les ha permitido aumentar el tiempo en faena, invirtiéndolo en el rubro de los combustibles, lubricantes y otros, necesarios para movilizar la embarcación. De esta forma han logrado aumentar el área de barrida y el tiempo en la búsqueda de los productos pesqueros.

En cuanto a los costos fijos relacionados directamente con la operación de pesca, les ha permitido a los armadores un manejo temporal-financiero, como el mantenimiento de la motonave, del "wincher" y de las compuertas, que les generan créditos con el comercio de mantenimiento y está representado con el 5,8% de los costos totales. En cuanto al costo de oportunidad y como concepto económico es el más alto, pero desde el punto de vista del concepto del armador es su alternativa de trabajo y su conocimiento del negocio.

TABLA 5. Estructura de costos de operación de la faena del 3 al 23 de noviembre de 1999 – Motonave Doña Rosario

| CONCEPTO ECONÓMICO | COSTO – FAENA (dólares americanos) | PARTICIPACIÓN (%) |
|---|---|---|
| **COSTOS VARIABLES** | **4.433,96** | **77,6** |
| Combustible y lubricantes | 3.136,00 | 54,9 |
| Avituallamiento | 254,00 | 4,4 |
| Equipo de pesca | 15,00 | 0,3 |
| Salario tripulación | 828,96 | 14,5 |
| Otros (no especifica) | 200,00 | 3,5 |
| **COSTOS FIJOS** | **5.711,10** | **22,4** |
| Muellaje | 10,50 | 0,2 |
| Permiso de pesca | 37,85 | 0,7 |
| Salubridad | 9,33 | 0,2 |
| Capitanía | 2,00 | 0,0 |
| Mantenimiento M/N | 291,67 | 5,1 |
| Mantenimiento "wincher" | 29,17 | 0,5 |
| Mantenimiento compuertas | 9,72 | 0,2 |
| Costo de oportunidad inversión (8 %) | 886,90 | 15,5 |
| **COSTO TOTAL DE LA FAENA** | **5.711,10** | **100,0** |

La tabla 6, presenta los costos unitarios alcanzados en la faena utilizada como muestra de comportamiento. En la misma se puede observar que el costo total unitario alcanzó los 0,82 dólares americanos por libra producida. Este precio de producción tiene una relación directa con los precios de venta.

El costo variable unitario, que se relaciona con todos los insumos orientados hacia la operación de la motonave en la actividad de pesca, alcanza los 0,64 dólares americanos por libra. Sin embargo, los costos más sobresalientes corresponden al consumo del combustible y los salarios de la tripulación, que presentan un valor de 0,57 dólares americanos.

En cuanto al costo fijo unitario, son costos que son manejables financieramente, pero como se dijo anteriormente el armador ha sacrificado seguridad para la motonave al retirarle el costo de seguros de la embarcación, costo que en la práctica es bastante oneroso en la estructura de los costos.

Lógicamente, los costos fijos para el análisis que se desarrolla con una sola información -de una faena- no corresponden a una realidad económica, pues solamente nos muestran unos resultados muy precisos de un sólc evento de captura, pero permitirían inducir un posible comportamiento periódico, el cual no es homogéneo con la verdadera situación y actividad pesquera.

**TABLA 6. Costos unitarios de producción para la faena de arrastre de camarón en aguas someras**

| CONCEPTO ECONÓMICO | CVU (dólares por libra) |
|---|---|
| **COSTO VARIABLE** | |
| Combustible y lubricantes | 0,45 |
| Avituallamiento | 0,04 |
| Equipo de pesca | 0,00 |
| Salario tripulación | 0,12 |
| Otros (no específica) | 0,03 |
| **Subtotal** | **0,64** |

| CONCEPTO ECONÓMICO | CVU (dólares por libra) |
|---|---|
| **COSTO FIJO** | |
| Muellaje | 0,00 |
| Permiso de pesca | 0,01 |
| Salubridad | 0,00 |
| Capitanía | 0,00 |
| Mantenimiento M/N | 0,04 |
| Mantenimiento "wincher" | 0,00 |
| Mantenimiento compuertas | 0,00 |
| Costo de oportunidad inversión (8 %) | 0,13 |
| **Subtotal** | **0,18** |
| **COSTO UNITARIO- FAENA** | **0,82** |

### 3.3.4 Estructura de los ingresos de la motonave arrastrera

Los ingresos de esta actividad pesquera están en función de los resultados aleatorios de la producción pesquera, así como también, de los precios del mercado internacional, para los productos de exportación, y los de consumo nacional por la oferta y demanda locales.

A pesar de que el mercado internacional del producto camaronero impone los precios y exigencias de calidad, clasificación y presentación del camarón (Polo *et al.*, 1990) a los productos colombianos; los precios para este estudio serán deducidos de los ingresos brutos proporcionados por el armador como resultado de la faena.

Los ingresos de la faena se conforman básicamente de dos conceptos: venta del producto objetivo de la pesquería representada por el camarón y la segunda por la venta del producto de la "fauna acompañante".

**TABLA 7. Estructura de los ingresos brutos de la Motonave Doña Rosario en aguas someras**

| PRODUCTO | MERCADO (dólares americanos) | |
|---|---|---|
| | Exportación | Nacional |
| 1.- Camarones | 7.559,8 | 130,7 |
| 2.- Fauna Acompañante | | 1.924,75 |
| a.- Peces * | | 1.774,75 |
| b.- Moluscos | | 150,00 |
| **Subtotal ingresos** | **7.559,8** | **2.055,45** |
| **TOTAL INGRESOS BRUTOS** | **9.615,25** | |

* Excluye productos de fauna de pescado menudo- sin valor comercial

La tabla 7, muestra que los ingresos totales de la motonave provienen de la venta de los productos destinados a la exportación (78,6%) más la venta de productos que abastecen el mercado nacional (21,4 %).

De acuerdo con la tabla 7, el mercado nacional absorbe en su totalidad los productos de la fauna acompañante, generando un ingreso de 2,0 mil dólares americanos por faena. Estos ingresos, provenientes de la venta de la fauna incidental en mercado nacional, están representados por la participación de peces, crustáceos y moluscos. La fauna incidental de peces participa con el 86,4%,

seguido de los moluscos con el 7,3% y los crustáceos con el 6,3 %, este último producto corresponde a la especie objeto de la pesquería, pero es distribuido en el mercado nacional debido a defectos del producto para el mercado de exportación.

### 3.3.5 Beneficios económicos de la motonave "Doña Rosario" en la pesquería de arrastre de aguas someras

La tabla 8, muestra en términos generales el balance pesquero de la faena, donde los costos son el 59,4% de los ingresos y el margen de utilidad el 68,36 %. Desde el punto de vista financiero, el margen presentado es aceptable como rendimiento en la operación. Sin embargo, las faenas de pesca siempre están supeditadas a la aleatoriedad pesquera y económica que presenta toda pesquería y debe considerarse un muestreo de mayor duración para conocer el verdadero comportamiento de la pesquería en su conjunto (camarones y fauna acompañante).

**TABLA 8. Beneficio económico neto de la operación pesquera en la faena de las aguas someras**

| PRODUCTO | Ingresos (dólares por libra) | Costo total (dólares por libra) | Beneficio Económico (dólares por libra) |
|---|---|---|---|
| 1. - Camarones | 7.559,80 | | |
| 2. - Fauna Acompañante | 2.055,45 | | |
| Balance Pesquero | 9.615,25 | 5.711,10 | 3.904,15 |
| Proporción de Relación (%) | 100,00 | 59,40 | 68,36 |

### 3.3.6 Indicadores económicos de evaluación de la motonave "Doña Rosario"

La importancia económica de la actividad extractiva depende de la existencia de las reservas económicas pesqueras y de los rendimientos que presenten los recursos en el medio natural en cuanto a su abundancia; reflejados en el agotamiento de las poblaciones, resultado de los efectos de la tecnología mediante la cual son aprovechados.

De tal manera que la reserva económica natural en el medio marino, hace de la pesquería una actividad comercial próspera o limitada para efectos del desarrollo económico pesquero. Por esto el desarrollo sostenible es una condición "sine qua non" para que exista el desarrollo económico pesquero en el mediano y el largo plazo (Polo, 1998).

Los anteriores acápites toman forma e importancia para el siguiente análisis cuando se hace uso y aprovechamiento de una pesquería a través de inversiones económicas que buscan la explotación de estos recursos naturales, como entes individuales o comunitarios, y como alternativas de inversión, producción, empleo y creación de riqueza.

Por otro lado, la administración de las reservas económicas naturales que propendan por mantener un desarrollo sostenible de estas poblaciones, debe garantizarse con un nivel de esfuerzo económico racionalmente equitativo frente a la capacidad reproductiva de estos recursos la que actualmente aún es incierta y la intensidad de explotación industrial en el largo plazo.

Evaluados económicamente las faenas se pueden tomar como primera aproximación y como idea de proyecto, donde se puede decir que comparativamente las ventajas económicas en términos generales favorecen la pesquería de arrastre, considerando la vida económica de cada uno en 8 meses. La evaluación que se mostrará en las siguientes páginas corresponde a estimaciones sin financiamiento para estos proyectos.

Los resultados de la evaluación económica para la motonave "Doña Rosario", se presentan en la tabla 9, donde se supone que el marco de inversión corresponde a la inversión fija valorada en 190.000 dólares americanos 3/.

**TABLA 9. Valor actualizado de las inversiones y beneficios para la M/N Doña Rosario**

| VALOR ACTUALIZADO 10 % | VALOR ACTUALIZADO 20% |
|---|---|
| (190.000) | (190.000) |
| 42.591 | 39.042 |
| 38.719 | 32.535 |
| 35.199 | 27.112 |
| 31.999 | 22.593 |
| 29.090 | 18.828 |
| 26.445 | 15.690 |
| 24.041 | 13.075 |
| 21.856 | 10.896 |

La tabla 9, presenta los valores actualizados correspondientes a los guarismos económicos calculados para la motonave, donde la tasa interna de retorno (TIR) es del 18,54% y es donde el valor presente neto (VPN) se iguala a "cero". Este indicador se corrobora mediante la utilización de la función TIR de Excel estimando que es del 18,18 %. Esta tasa muestra el rendimiento real de la inversión total o de los recursos económicos aportados para realizar la actividad de captura.

Otro indicador cuantitativo importante corresponde al valor presente neto estimado para estos proyectos, el cual es obtenido mediante la actualización de los flujos de efectivo del proyecto y evaluada utilizando la tasa del DTF (18%) reportada por algunas instituciones financieras del país.

El VPN para la motonave alcanza a los 59,9 millones de dólares. El beneficio-costo para las inversiones de la pesca de arrastre en las aguas someras y como negocio o inversión presenta un indicador de 1,03 interpretado bajo los valores generales del único muestreo, este es un proyecto de inversión que toma una posición de indiferencia económica.

## 3.4 LA FLOTA DE ARRASTRE DE LAS AGUAS PROFUNDAS DEL PACIFICO COLOMBIANO

Para la pesca de arrastre del camarón de aguas profundas se han considerado veriles de profundidades de 40 a 100 brazas en adelante. Es decir, que a estas profundidades estaríamos hablando de pesca de arrastre para el camarón de aguas profundas.

Para 1999, la flota arrastrera de aguas profundas está compuesta por 39 embarcaciones de las cuales el 48,8% son de bandera colombiana seguida de las motonaves panameñas con el 33,3 %, el 15,4% de bandera beliziana y el 2,5% de bandera ecuatoriana. Dentro de estas motonaves el 79,5% son embarcaciones activas, el 12,8% son embarcaciones inactivas y el 7,7% corresponden a las de "pesca mixta".

Para la caracterización y clasificación de la flota (Tabla 10), se distribuye por intervalos relacionados con el TRN mostrando 5 grupos. El primer grupo está compuesto por 10 motonaves (25,6 %), el segundo por 6 motonaves (15,4 %), el tercer grupo representado por 14 motonaves (35,9 %), un cuarto grupo con 7 barcos (17,9 %) y el quinto grupo con 2 embarcaciones (5,1 %).

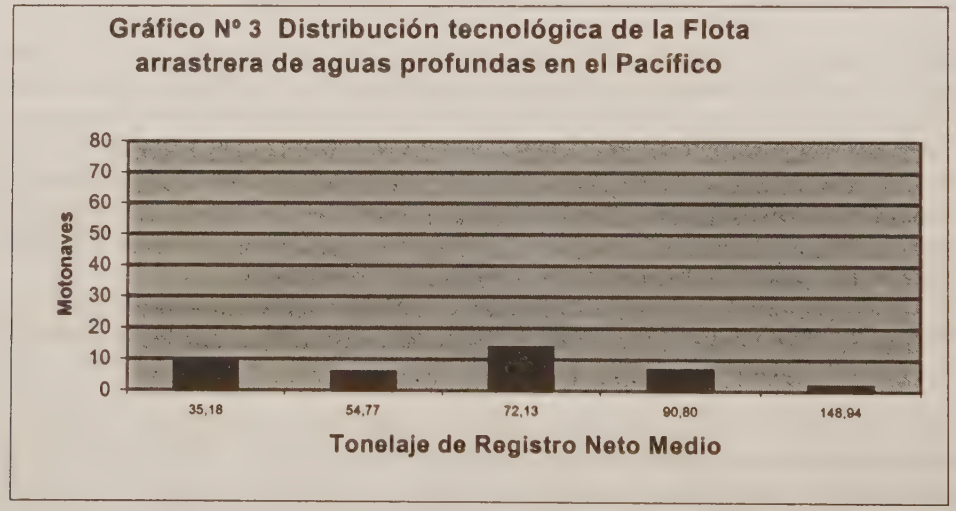
---

3 / Vale aclarar, que estos resultados corresponden a una única observación pesquera, que sólo lleva a encontrar sugerencias muy puntuales; datos parciales que no reflejan el verdadero comportamiento pesquero-económico-ambiental, cuya incidencia económica debe evaluarse por lo menos en el corto y mediano plazo.

**TABLA 10. Clasificación técnico-económica de las motonaves de arrastre para aguas profundas según el TRN y al TRB**

| INTERVALO TRN (toneladas) | COMPOSICIÓN No. de motonaves | TRN Medio (toneladas) | TRB Medio (toneladas) | Coeficiente Técnico Medio |
|---|---|---|---|---|
| 20,0 – 40 | 10 | 35,18 | 80,40 | 0,44 |
| 40,1 – 60 | 6 | 54,77 | 85,2 | 0,64 |
| 60,1 – 80 | 14 | 72,13 | 103,81 | 0,69 |
| 80,1 – 100 | 7 | 90,80 | 105,38 | 0,68 |
| 100 y más | 2 | 148,94 | 467,99 | 0,32 |
| TOTAL | 39 | 80,36 | 168,56 | 0,59 |

Actualmente, las inversiones en motonaves de camarones para aguas profundas se dividen en dos tendencias, la primera se concentra en el intervalo de las 20 a las 40 toneladas de TRN, que se asimilan a motonaves del rango de las aguas someras. La segunda tendencia se concentra en embarcaciones, que por su tamaño son destinadas a aguas profundas y a demás por la relación que presentan con respecto al coeficiente técnico, formando el 74,4% de la flota, cuya tendencia pesquera se da por encima de las 54,7 a las 148,9 toneladas de TRN.




**Otras características técnico-económicas de la flota de aguas profundas**

Siguiendo el patrón utilizado para clasificar la flota (TRN), y en términos generales, se ha identificado que el 82,1% de las motonaves poseen casco de acero y el 17,9% lo tienen en hierro (Tabla 11).

Al observar la composición de los intervalos del grupo con casco de acero (32), se evidencia que el 43,7% lo componen las motonaves que forman el intervalo de 60,1 a 80 toneladas, mientras que el intervalo de 80,1 a 100 toneladas representa el 18,8 %. Estos dos grupos forman el 62,5% del grupo que predomina con casco de acero con tendencia a concentrase por encima de las 80 toneladas de TRN (Tabla 11).

Las motonaves que componen el grupo de las embarcaciones con casco de hierro (7) forman el intervalo de 20 a 60 toneladas, seguidas del intervalo de 40,1 a 60 toneladas, cuya tendencia es a la utilización de tonelaje de registro neto menor a las 60 toneladas de TRN. Podría decirse que son motonaves con características para las pesquerías de las aguas someras.

**TABLA 11. Caracterización técnico-económica de las motonaves de camarón de aguas profundas según el casco y grupo clasificado con base en el TRN**

| INTERVALO TRN (toneladas) | TRN Medio (toneladas) | CASCO ACERO | CASCO HIERRO |
|---|---|---|---|
| 20.0 – 40 | 38.15 | 6 | 4 |
| 40.1 – 60 | 54.77 | 4 | 2 |
| 60.1 – 80 | 72.13 | 14 | 0 |
| 80.1 – 100 | 90.80 | 6 | 1 |
| 100 y MÁS | 148.94 | 2 | 0 |
| TOTAL (%) | | 82.1 | 17.9 |

La tabla 12, presenta las dimensiones para la navegación de las embarcaciones según los intervalos caracterizado para su clasificación en estas motonaves.

**TABLA 12. Caracterización técnico-económica de las motonaves de camarón de aguas profundas. Según dimensiones de navegación por grupo clasificado con base en el TRN**

| INTERVALO TRN (toneladas) | Motonaves Número | Eslora Promedio | Manga Promedio | Calado Promedio |
|---|---|---|---|---|
| 20.0 – 40 | 10 | 20.80 | 6.13 | 2.48 |
| 40.1 – 60 | 6 | 22.68 | 6.45 | 2.03 |
| 60.1 – 80 | 14 | 20.42 | 6.43 | 2.49 |
| 80.1 – 100 | 7 | 22.00 | 6.61 | 2.55 |
| 100 y más | 2 | 36.66 | 7.65 | 5.10 |

## 3.5 CARACTERIZACIÓN ECONÓMICA DE LA FLOTA ARRASTRERA EN AGUAS PROFUNDAS

La composición de la flota de aguas profundas no presenta un modelo específico de motonave, para la producción de captura de camarón en este tipo de pesquería, que garantice la eficiencia técnica y la eficiencia económica. Se puede decir que en la pesquería de la flota de arrastre del camarón de aguas profundas, la tendencia es a realizar inversiones por encima a las 80 a hasta las 100 toneladas de TRN cuyo coeficiente técnico mínimo es oscilatorio en 0,69 y un máximo de 0,86.

De acuerdo con la variable establecida (TRN) para la clasificación de la flota pesquera de camarón de las aguas profundas (Tabla 10), se identificaron dos tipos de motonaves que realmente extraían camarones de esta pesquería. Desde el punto de vista de inversión se considera como motonaves pequeñas las que ocupan el intervalo de 20 a 40 toneladas de TRN y como motonaves grandes, las que ocupan el intervalo de 40,1 a 100 toneladas de TRN.

En términos generales, las inversiones de acuerdo al muestreo único que se realizó y para los intervalos 80,1 a 100 toneladas y el intervalo de 60,1 a 80 toneladas de TRN, donde fueron seleccionadas la embarcaciones de estudio, se estiman en 2,1 millones de dólares y 1,7 millones de dólares respectivamente. Es decir, que en los dos intervalos consultados, la flota tiene un valor de 3,8 millones de dólares, en la pesquería de aguas profundas.

## 3.6 ANÁLISIS ECONÓMICO PARA LA MOTONAVE ARRASTRERA " ARRAIJAN" DE AGUAS PROFUNDAS EN 1999

La presente evaluación económica corresponde a una aproximación dada por la operación de la única faena que sirve como muestreo puntual para conocer a grandes rasgos el comportamiento de la pesquería con arrastreros de camarón en aguas profundas, los cuales involucran en este tipo de método de captura a la fauna íctica, poblaciones pertenecientes a otras pesquerías.

De acuerdo con los registros del propietario, el valor-inversión-fija de esta embarcación equipada para 1999 es de aproximadamente 300.000 dólares americanos. Esta motonave tiene permiso de pesca, para operar en la pesquería arrastrera de camarones de aguas someras y profundas. La edad de esta embarcación es de 13 años, con un motor de 365 H.P.

Se caracteriza por poseer un tonelaje de registro bruto de 85,18 toneladas y un tonelaje de registro neto de 55 toneladas, con un coeficiente técnico de 0,64. Para el estudio, se identifica como embarcación perteneciente al intervalo 40,1 a 60 toneladas (Tabla 9), infiriendo los resultados de un muestreo realizado para esta motonave, a la composición de las embarcaciones que forman este grupo, representando el 15,4% de la flota con operación en aguas someras.

Los datos, y el análisis, que se presentan a continuación corresponden a los resultados de una faena de pesca de 19 días duración, realizada del 2 al 19 de diciembre de 1999.

Debe tenerse en cuenta que una faena no es representativa para el estudio y análisis de un comportamiento económico adecuado como actividad empresarial, por lo cual, se sugiere una investigación más prolongada que permita medir los resultados durante un período mínimo de muestreo de 12 meses.

### 3.6.1 Inversión económica de la motonave "Arraijan"

Las inversiones estimadas para la operación de esta motonave en las aguas someras se pueden distribuir principalmente en dos conceptos:

| | | |
|---|---|---|
| INVERSIÓN FIJA: | 300.000,00 | DÓLARES AMERICANOS |
| CAPITAL DE TRABAJO- FAENA: | 8.500,00 | DÓLARES AMERICANOS |
| TOTAL INVERSIÓN: | 308.500,00 | DÓLARES AMERICANOS |

La inversión fija corresponde a una embarcación con todo el aditamento pesquero para ser operada en las aguas profundas en busca del camarón, principal producto del permiso otorgado por el INPA, y que por ejercicio de esta operación también se capturan productos pertenecientes a otras pesquerías, entre estos, los productos de la pesca blanca.

### 3.6.2 Rendimientos económicos de la producción de arrastre

El concepto de rendimiento está dado por el volumen del producto extraído del medio natural, tanto en productos de camarón como de los productos que componen la fauna incidental, obtenida con el método con que se captura el producto principal objeto de la pesquería.

De acuerdo con la información compilada para la faena en estudio de la motonave Arraijan, la tabla 13, presenta los siguientes resultados físicos de producción:

La tabla 13, presenta la producción obtenida de la captura en la faena de 19 días, donde se observa que el 61,1% de la producción de esta motonave corresponde a la denominada "fauna acompañante" y el 38,9% al producto camarón objeto de esta pesquería de arrastre.

Del total de la producción se puede decir que el 58,2% corresponde a peces de especies pelágicas, demersales y bentónicas.

En cuanto a los crustáceos, fueron reportados el camarón blanco, el coliflor y el pink que componen el 38,9% de la producción total y que son el objeto de esta pesquería.

**TABLA 13. Producción y rendimiento de la captura de arrastre y la fauna acompañante**

| Producto Pesquero | Producción (libras) | Participación (%) |
|---|---|---|
| **PECES** | | |
| Sierra | 206 | 3,7 |
| Pargo lunarejo | 482 | 8,6 |
| Zafiro | 230 | 4,1 |
| Toyo | 148 | 2,6 |
| Lenguado | 522 | 9,3 |
| Berrugate | 672 | 12,0 |
| Alguacil | 14 | 0,3 |
| Pez rey | 200 | 3,6 |
| Ñato | 660 | 11,8 |
| Merito | 68 | 1,2 |
| Toyo | 54 | 1,0 |
| **Subtotal** | **3.256** | **58,2** |
| **CRUSTÁCEOS** | | |
| Camarón | 2.179 | 38,9 |
| **Subtotal** | **2.179** | **38,9** |
| **MOLUSCOS** | | |
| Calamar | 120 | 2,1 |
| Caracol | 42 | 0,8 |
| **Subtotal** | **162** | **2,9** |
| **TOTAL FAUNA INCIDENTAL** | **3.418** | **61,1** |
| **TOTAL CAMARÓN** | **2.179** | **38,9** |
| **TOTAL PRODUCCIÓN** | **5.597** | **100,0** |

### 3.6.3 Estructura de costos para la operación y producción de la motonave arrastrera "Arraijan"

Los costos que muestra la tabla 14, corresponden a la información recogida de la faena de diciembre de 1999 para establecer la estructura de los costos. En esta tabla, los costos se han clasificado en variables y fijos relacionados directamente con la actividad pesquera, donde los costos variables son el 81,6% y los costos fijos forman el 18,4% de los costos totales.

**TABLA 14. Costos de operación de la faena del 2 al 19 de diciembre de 1999 - motonave "Arraijan"**

| CONCEPTO | COSTO – FAENA (dólares americanos) | Participación (%) |
|---|---|---|
| **COSTOS VARIABLES** | | |
| Combustible y lubricantes | 4.400,00 | 48,7 |
| Avituallamiento | 300,00 | 3,3 |
| Equipo de pesca | 15,00 | 0,2 |
| Salario Tripulación | 2.498,20 | 27,7 |
| Otros (no específica) | 150,00 | 1,7 |
| **Subtotal** | **7.363,20** | **81,6** |

| CONCEPTO | COSTO – FAENA (dólares americanos) | Participación (%) |
|---|---|---|
| **COSTOS FIJOS** | | |
| Muellaje | 15,00 | 0,2 |
| Permiso de Pesca | 37,85 | 0,4 |
| Salubridad | 9,33 | 0,1 |
| Capitanía | 2,00 | 0,0 |
| Mantenimiento M/N | 296,50 | 3,3 |
| Mantenimiento "wincher" | 37,50 | 0,4 |
| Mantenimiento Compuertas | 32,50 | 0,4 |
| Costo de Oportunidad Inversión(8%) | 1.234,00 | 13,7 |
| **Subtotal** | **1.664,68** | **18,4** |
| **COSTO TOTAL DE LA FAENA** | **9.027,89** | **100,0** |

Dentro de los costos variables se puede apreciar que los costos de combustible y lubricantes, junto con los costos laborales, representan el mayor peso en la estructura formando el 76,4 %.

La tabla 15, presenta los costos unitarios alcanzados en la faena utilizada como muestra de comportamiento, donde se puede observar que el costo total unitario alcanzó los 1,62 dólares americanos por libra producida.

El costo variable unitario, que se relaciona con todos los insumos orientados hacia la operación de la motonave en la actividad de pesca, alcanza los 1,32 dólares americanos por libra. Sin embargo, los costos más sobresalientes corresponden al consumo del combustible y los salarios de la tripulación que presentan un valor de 1,32 dólares americanos por libra producida.

En cuanto al costo fijo unitario, son costos que son manejables financieramente, pero como se dijo anteriormente el armador ha sacrificado seguridad para la motonave al retirarle el costo de seguros de la embarcación, costo que en la práctica es bastante oneroso en la estructura de los costos.

**TABLA 15. Costos unitarios de producción para la faena de arrastre de camarón**

| CONCEPTO ECONÓMICO | CVU (dólares por libra) |
|---|---|
| **COSTO VARIABLE** | |
| Combustible y lubricantes | 0,79 |
| Avituallamiento | 0,05 |
| Equipo de pesca | 0,00 |
| Salario tripulación | 0,45 |
| Otros (no específica) | 0,03 |
| **Subtotal** | **1,32** |
| **COSTO FIJO** | |
| Muellaje | 0,00 |
| Permiso de pesca | 0,01 |
| Salubridad | 0,00 |
| Capitanía | 0,00 |
| Mantenimiento M/N | 0,05 |
| Mantenimiento "wincher" | 0,01 |
| Mantenimiento compuertas | 0,01 |
| Costo de oportunidad inversión (8 %) | 0,22 |
| **Subtotal** | **0,30** |
| **COSTO UNITARIO- FAENA** | **1,62** |

Lógicamente, los costos fijos para el análisis que se desarrolla con una sola información - de una faena - no corresponden a una realidad económica, pues solamente nos muestran unos resultados muy precisos de un sólo evento de captura, pero permitirían inducir un posible comportamiento periódico, el cual no es homogéneo con la verdadera situación y actividad pesquera.

### 3.6.4 Estructura de los ingresos de la motonave arrastrera

Los ingresos de esta actividad pesquera están en función de los resultados aleatorios de la producción pesquera, así como también, de los precios del mercado internacional, para los productos de exportación, y los de consumo nacional por la oferta y demanda locales.

A pesar de que el mercado internacional del producto camaronero impone los precios y exigencias de calidad, clasificación y presentación del camarón (Polo *et al.*, 1990) a los productos colombianos; los precios para este estudio serán deducidos de los ingresos brutos proporcionados por el armador como resultado de la faena.

Los ingresos de la faena se conforman básicamente de dos conceptos: venta del producto objetivo de la pesquería representada por el camarón y la segunda por la venta del producto de la "fauna acompañante".

**TABLA 16. Estructura de los ingresos brutos de la Motonave Arraijan en aguas profundas**

| PRODUCTO | MERCADO (dólares americanos) | |
|---|---|---|
| | Exportación | Nacional |
| 1.- Camarones | 2.380,8 | 1.469,40 |
| 2.- Fauna Acompañante | | 2.523,00 |
| a.- Peces | | 2.500,00 |
| b.- Moluscos | | 23,00 |
| **Subtotal ingresos** | 2.380,8 | 3.992,40 |
| **TOTAL INGRESOS BRUTOS** | **6.373,20** | |

La tabla 16, muestra que los ingresos totales de la motonave que provienen de la venta de los productos destinados a la exportación (37,4%) más la venta de productos que abastecen el mercado nacional (62,6%). Cabe destacar que de la producción del camarón, el 65,9% se destinó al mercado nacional, supuestamente porque no llenó los requisitos exigidos para su exportación.

De acuerdo con la tabla 16, el mercado nacional absorbe en su totalidad los productos de la fauna acompañante y algunos camarones de tipo nacional, generando un ingreso de 3.9 mil dólares americanos por faena. La fauna de peces participa con el 62,6%, seguido de los moluscos con el 0,58% y los crustáceos con el 36,8%, este último producto corresponde a la especie objeto de la pesquería, pero es distribuido en el mercado nacional debido a defectos del producto para el mercado de exportación.

### 3.6.5 Beneficios económicos de la motonave "Arraijan" en la pesquería de arrastre de aguas profundas

La tabla 17, muestra en términos generales el balance pesquero de la faena, donde los costos son 1,41% superiores a los ingresos y el margen de utilidad es negativo. Sin embargo, las faenas de pesca siempre están supeditadas a la aleatoriedad pesquera y económica que presenta toda pesquería y debe considerarse un muestreo de mayor duración para conocer el verdadero comportamiento de la pesquería en su conjunto (camarones y fauna acompañante).

**TABLA 17. Beneficio económico neto de la operación pesquera en la faena de las aguas profundas**

| PRODUCTO | Ingresos (dólares por libra) | Costo total (dólares por libra) | Beneficio Económico (dólares por libra) |
|---|---|---|---|
| 1.- Camarones | 2.380,80 | | |
| 2.- Fauna Acompañante | 3.992,40 | | |
| Balance Pesquero | 6.373,20 | 9,027,89 | (2.654,69) |
| Proporción de Relación (%) | 100,00 | 141,65 | (29,41) |

### 3.6.6 Indicadores económicos de evaluación de la motonave "Arraijan"

La importancia económica de la actividad extractiva depende de la existencia de las reservas económicas pesqueras y los rendimientos que presenten los recursos en el medio natural en cuanto a su abundancia; reflejados en el agotamiento de las poblaciones, resultado de los efectos de la tecnología mediante la cual son aprovechados.

Por otro lado, la administración de las reservas económicas naturales que propendan por mantener un desarrollo sostenible de estas poblaciones, debe garantizarse con un nivel de esfuerzo económico racionalmente equitativo frente a la capacidad reproductiva de estos recursos la que actualmente aun es incierta y la intensidad de explotación industrial en el largo plazo.

Los resultados de la evaluación económica para la motonave "Arraijan" se presentan en la tabla 16, donde se supone que el marco de inversión corresponde a la inversión fija valorada en 300.000 dólares americanos, aparentemente no presenta rendimientos económicos suficientes arrojando pérdidas en la faena. Sin embargo, es necesario notar que esta evaluación corresponde a una faena de pesca, la cual no resulta representativa en un período económico normal.

## 4. ÁREA PESQUERA DEL CARIBE COLOMBIANO

### 4.1 ÁREA DE PESCA EN EL CARIBE COLOMBIANO

La costa Caribe tiene una longitud de 1.560 kilómetros, comprendidos entre los sitios de Cabo Tiburón (77° 20'; 8° 40' N), que marca la frontera con Panamá, y la desembocadura del río Sillamaná (71° 25'O; 11° 50' N) en la frontera con Venezuela. La base continental presenta las siguientes características:

Desde Cabo Tiburón hasta Punta Arenas, formando el golfo de Urabá, la costa es baja, pantanosa y selvática.

Desde Punta Arenas hasta Bahía de Barbacoas (Punta Barú), las playas son amplias y arenosas.

Desde Punta Barú hasta Punta Manzanillo, incluyendo las islas de San Bernarnado y Rosario, la costa es coralina.

Desde Punta Manzanillo hasta Gaira, es anegadiza, pantanosa y con numerosas ciénagas formadas por el Río Magdalena.

De Gaira nasta Mendiguaca, que comprende la vertiente de la Sierra Nevada de Santa Marta, es rocosa y coralina.

Desde Mendiguaca hasta la frontera con Venezuela, es arenosa. En escasos puntos de poca extensión, se encuentran formaciones coralinas y rocosas, como en el cabo de la Vela.

La plataforma continental, según cartografía, en esta zona tiene las siguientes características:

Turbo: amplia (la totalidad del golfo); Tolú mediana; de Cartagena a la vertiente de la Sierra Nevada de Santa Marta, reducida y en Riohacha, amplia.

Dentro de las extensiones insulares de esta costa, está el Archipiélago de San Andrés y Providencia (12° 0' y 16° 30' N; 78° y 82° 0' W), a unas 450 millas al noroeste del continente. Comprende las islas de San Andrés, Providencia, Santa Catalina y los Cayos de Roncador, Serrana y Quita Sueño. Siguen en importancia el archipiélago de San Bernardo, formado por 8 islotes ubicados al norte del golfo de Morrosquillo, con una extensión de 399 hectáreas. Pueden mencionarse, además, las islas del Rosario, Barú y Tierra Bomba, en las proximidades de la bahía de Cartagena.

## 4.2 RECURSOS PESQUEROS DEL CARIBE COLOMBIANO

Los recursos pesqueros, al nivel de peces, están constituidos por la fauna acompañante que generalmente predomina en la captura del camarón. Dependiendo del área de captura, se pueden agrupar por especímenes, según se indica a continuación:

COSTEROS: Sus ciclos vitales están relacionados con zonas de manglar, lagunas y esteros (lisa, mojarra, robalo, bagre, entre otros). En la actualidad son explotadas a escala artesanal.

PELÁGICOS PRIMARIOS:
DEMERSALES:
TIBURONES.

## 4.3 DISTRIBUCIÓN BIOGEOGRÁFICA DE LOS PECES

El litoral del Caribe colombiano se subdivide en áreas pesqueras, en las cuales se han realizado evaluaciones de los recursos pesqueros. La pesca exploratoria efectuada con redes de fondo y media agua, reportó un potencial aproximado de 55.000 toneladas de especies de valor comercial con un rendimiento potencial de 29.000 toneladas de peces de varias clases (1978), según se muestra en el mapa 2 (página 37).

Las prospecciones realizadas a lo largo de la costa, entre las 5 y 300 brazas (de 9 a 600 metros), cubriendo desde la frontera con Panamá hasta Punta Mestizos (sureste de Cartagena), frente a Bahía de Cispatá (Golfo de Morrosquillo), sólo identificaron dos sitios de alta concentración, ubicados uno al noroeste del golfo de Urabá, muy cercano a la costa, aproximadamente sobre las 20 a 30 brazas, y el segundo un poco al este de Punta Arboletes, sobre el veril exterior a las 150 brazas, mostrando una gran dispersión de las especies en el resto del área.

La zona desde Cartagena a Puerto Colombia, sólo presenta un lugar de alta concentración localizado en Bahía de Samba (entre Punta Canoas y Punta Galera), ubicado entre las 4 y 6,2 brazas y concentraciones aisladas sobre las 26 y 188 brazas (14,4 –340 metros). El resto de la zona presenta gran dispersión y es previsible que la captura por métodos artesanales deba efectuarse mediante un elevado esfuerzo. En las observaciones entre Bocas de Ceniza (desembocadura del río Magdalena) y el meridiano 73° Oeste, las concentraciones se dan frente a la Ciénaga Grande de Santa Marta, que se extiende desde el parque isla de Salamanca, entre las 7 y las 70 brazas, llegando hasta la Punta del Aeropuerto de Santa Marta. Posteriormente aparece otra concentración frente al Parque Nacional Tayrona.

Las concentraciones más importantes se encuentran, casi en forma continua, desde esta zona hacia el noreste sobre los veriles de 12 y 22 brazas extendiéndose hacia fuera hasta las 40 –50 brazas, y en ocasiones a mayores profundidades.

Frente a las zonas de Dibulla, Camarones, Riohacha, Manaure hasta el cabo de la Vela, sobre veriles de profundidad relativamente cercanos a la costa

**Camarones del Caribe (*Penaeus schmitti, P. duorarum, P. brasiliensis*)**

Están distribuidos a lo largo de la costa en diferentes profundidades. El blanco se distribuye entre las 3 - 7 brazas y los rosados, entre las 8 y las 40 brazas, concentrándose principalmente entre las 10 y 25 brazas. Se considera que la cifra indicada como potencial de estas especies (1.300 toneladas) está subestimada, dado que el área de distribución ha sido disminuida en un 25 %, como margen de seguridad.

## 4.4 CONCLUSIONES

En las diferentes investigaciones efectuadas, en distintas épocas, en el área de la costa del Pacífico coinciden dos zonas específicas: el norte de Buenaventura y al sur de Buenaventura. Sin embargo, Buenaventura siempre ha sido el centro de separación fisiográfica de la costa pacífica.

Una vez clasificadas las motonaves se debe establecer la muestra estadística inicial. Sin embargo, como no todos los armadores colaboran durante la recopilación de la información, la muestra tiende a desmembrarse. Por lo tanto, deberá aplicarse el ajuste de una nueva muestra por el método de FES y FEO, al método utilizado en 1989 para trabajos similares. Esto debe realizarse, considerando que cualquier motonave en esta pesquería tiene igual opción económica de ser observada como inversión comercial y elemento bioeconómico en el medio natural.

# 5. ANÁLISIS DE RESULTADOS BIOLÓGICO-PESQUEROS

## 5.1 ANÁLISIS DE TALLAS PARA LAS ESPECIES CAPTURADAS EN EL ATLÁNTICO

**PARGO** (*Lutjanus synagris*): La distribución de tallas muestra que en el primer crucero se registraron capturas desde los 13 centímetros, las mayores frecuencias están entre las tallas de 19 a 21 centímetros, por esta razón podemos afirmar que allí se encuentra la talla modal (Figura 2).

Para el segundo crucero las capturas son registradas a partir de los 10 centímetros pero la talla modal cambió al rango entre los 16 y 18 centímetros (Figura 3).

La FAO reporta tallas comunes hasta los 25 centímetros, que es un valor un poco más alto que el reportado por los dos cruceros.

**PERLA** (*Lepophidium brevibarbe*): En el primer crucero se registraron capturas de esta especie, a partir de los 13 centímetros, mientras que su frecuencia modal estuvo presente en el rango de los 19-21 centímetros (Figura 4).

Para el segundo crucero las condiciones de capturas son muy similares porque se siguen registrando tallas desde los 13 centímetros y con un rango modal entre los 19 - 21 centímetros (Figura 5).

La FAO reporta como talla más común los 20 centímetros; esto quiere decir que esta especie está siendo capturada dentro de los rangos comunes para la zona.

**PEZ HUEVO** (*Synodus foetens*): Se registran capturas desde los 16 centímetros, con una talla modal entre el rango de los 19-21 centímetros (Figura 6).

En el segundo crucero se registra una captura inicial de 20 centímetros, siendo este rango inicial (20-22 centímetros) de una alta densidad. No hay un registro claro de un rango modal visible ya que, desde la talla de los 20 centímetros hasta la talla de los 32 centímetros, las frecuencias son muy similares y en general, en este crucero, las tallas fueron un poco superior al anterior (Figura 7).

La talla más común registrada por la FAO es de 30 centímetros. Esta cifra concuerda con los datos obtenidos durante el segundo crucero, pero no con el primero.

**ESPEJUELO** (*Selene vomer*): Este recurso fue capturado en el primer crucero desde los 10 centímetros, con una talla modal en el rango de los 13-15 centímetros (Figura 8).

Durante el segundo crucero las condiciones de captura de esta especie son idénticas a las del primero.

Es decir, se empieza a capturar desde los 10 centímetros con una talla modal entre los 13-15 centímetros (Figura 9).

La FAO reporta una talla común de 35 centímetros. Este valor dista considerablemente de los valores reportados, durante los dos cruceros, para la talla modal.

**RAYA** (*Dasyatis guttata*): En el primer crucero se obtuvieron capturas desde los 19 centímetros. Dentro de las capturas se evidencian dos grupos, el primero con una talla modal entre los 25-27 centímetros y el segundo con un rango de talla modal entre 40-42 centímetros (Figura 10).

En el segundo crucero la talla de primera captura está alrededor de los 10 centímetros, con una talla modal entre los 40-42 centímetros, sin que se note una distribución normal de estas capturas o que se separen las distribuciones en varios grupos (Figura 11).

La talla más común reportada por la FAO es de 200 centímetros. Esto significa que en Colombia este recurso es capturado muy por debajo de los rangos reportados para el área.

**JUREL** (*Caranx crysos*): Durante el primer crucero se reportaron tallas desde los 13 centímetros, con una talla modal en el rango de los 16-18 centímetros. No se reportan tallas para el segundo crucero (Figura 12).

La FAO reporta tallas comunes a los 40 centímetros, registro por encima de la talla modal reportada para este estudio.

**RONCO** (*Conodon nobilis*): Sólo se reportan tallas para el primer crucero. Se reportan capturas desde los 19 centímetros, con una talla modal en el rango de los 22-24 centímetros (Figura 13).

La FAO reporta una talla común de 25 centímetros, lo cual se ajusta a las tallas reportadas en el primer crucero.

**BAGRE** (*Bagre marinus*): Durante el primer crucero se reportan tallas desde los 13 centímetros, con una talla modal en el rango de los 22-24 centímetros (Figura 14).

En el segundo crucero se registran capturas desde los 10 centímetros, con una talla modal en el rango de los 22-24 centímetros. Aunque la talla de captura en este crucero disminuye con respecto a la primera, la del grupo modal se mantiene (Figura 15).

La FAO reporta tallas comunes de 50 centímetros, el doble de la registrada para los dos cruceros.

**CASABITO** (*Chloroscombrus chrysurus*): Este recurso se presenta en el primer crucero desde los 13 centímetros, con una talla modal en el rango de los 16-18 centímetros (Figura 16).

Para el segundo crucero los registros son muy pobres, identificándose solamente las tallas registradas entre los 16-18 centímetros, lo que equivale a decir que prácticamente no se registraron datos de tallas (Figura 17).

La FAO reporta como talla común para el área la de 25 centímetros. Este valor no está muy alejado de los reportados durante esta evaluación.

**SABLE** (*Trichiurus lepturus*): Durante el primer crucero no se reporta una gran densidad de especímenes. Sin embargo, se registran tallas desde los 19 centímetros, pero no se destaca una talla modal en ninguno de los rangos (Figura 18).

En los datos del segundo crucero se nota una distribución más amplia y densa que en los datos del primero. Se reportan tallas desde los 42 centímetros hasta los 83 centímetros, con una talla modal en el rango de los 42-44 centímetros (Figura 19).

La FAO reporta tallas comunes a los 70 centímetros. Este valor está un poco distanciado del valor reportado para estos cruceros.

**CALAMAR** (*Loligo* sp.): Para el primer crucero se registran tallas desde los 16 centímetros, con una talla modal en el rango de los 19-21 centímetros (Figura 20).

Para el segundo crucero se registran tallas desde los 10 centímetros y la talla modal pertenece al rango de los 10-12 centímetros. Esto implica una disminución de talla de captura con respecto al primer crucero (Figura 21).

La FAO reporta 3 especies con tallas comunes que pueden variar entre los 7,2 y los 30 centímetros. Sin embargo, esto no asegura que las capturas de la especie se encuentren en los niveles comunes, porque desafortunadamente no fue posible identificar la especie.

**CORVINA** (*Cynoscion virescens*): En el primer crucero se reportan tallas a partir de los 16 centímetros, con una talla modal en el rango de los 22-24 centímetros (Figura 22).

Para el segundo crucero se reportan tallas a partir de los 20 centímetros, y la talla modal está en el rango de los 20-22 centímetros. En este crucero las tallas son un poco mas altas (Figura 23).

La FAO reporta una talla común de 65 centímetros, cifra que está muy por encima de la talla modal reportada para ambos cruceros.

**PLUMA CACHICATO** (*Calamus pennatula*): Solamente se reporta para el segundo crucero con tallas desde los 16 centímetros y con una talla modal en el rango de los 16-18 centímetros (Figura 24).

La FAO reporta tallas comunes alrededor de los 30 centímetros, rango un poco alejado del estimado para este crucero.

**LENGUADO** (*Achirus lineatus*): Solamente reportado para el segundo crucero, con tallas desde los 10 centímetros y con una talla modal en el rango de los 10-12 centímetros (Figura 25).

La FAO reporta talla común hasta los 17 centímetros, lo cual está dentro de los rangos reportados en este trabajo.

**MACHUELO** (*Opisthonema oglinum*): Reportado solamente para el segundo crucero con capturas desde los 10 centímetros y una talla modal en el rango de los 13-15 centímetros (Figura 26).

La FAO reporta tallas hasta de 20 centímetros, lo cual representa que las capturas de ésta especie están dentro un rango común al área.

**LANGOSTA** (*Panulirus argus*): Solamente está presente en el segundo crucero con capturas desde los 10 centímetros y con una talla modal en el rango de los 13-15 centímetros (Figura 27).

Aunque la FAO no reporta rangos medios, proporciona una longitud máxima de 45 centímetros que no es un registro contabilizado dentro de esta investigación.

**RAYA ESPINOSA** (*Raja cervigoni*): Esta especie es reportada solamente para el segundo crucero, tiene un amplio rango de distribución de tallas desde los 80 hasta 135 centímetros. Aunque no hay grupos modales formados, se puede observar una talla modal en el rango de los 80-85 centímetros (Figura 28).

La FAO reporta tallas comunes hasta los 30 centímetros, por lo tanto, los reportes de este crucero fueron más amplios que los registrados para el área.

**ROBALO** (*Centropomus undecimalis*): En el caso de esta especie se reportan tallas desde los 16 centímetros, solamente para el segundo crucero; no se visualiza un grupo modal claramente establecido aunque la talla modal está en el rango de los 25-27 centímetros (Figura 29).

La FAO reporta una talla común hasta los 50 centímetros, que es el doble de la máxima talla reportada para este crucero.

**LAMBE CALETERO** (*Menticirrhus americanus*): Esta especie es reportada sólo en el segundo crucero, con capturas desde los 20 centímetros y una talla modal en el rango de los 20-22 centímetros (Figura 30).

La FAO reporta tallas comunes hasta los 30 centímetros. Este valor se ajusta en los reportados en este estudio.

**RONCO JENIGUANO** (*Haemulon aurolineatum*): Esta especie es reportada sólo en el segundo crucero y presenta capturas desde los 20 centímetros, con una talla modal en el rango 20-22 centímetros (Figura 31).

La FAO reporta una talla común hasta los 18 centímetros. Este valor es inferior a lo trabajado en este crucero.

**GUITARRA** (*Rhinobatos percellens*): Se reportan tallas solamente para el segundo crucero, presentando capturas desde los 30 centímetros y con dos grupos modales, uno con una talla modal en el rango de los 40-42 centímetros y otro con una talla modal en el rango de los 50-52 centímetros (Figura 32).

La FAO reporta tallas comunes hasta los 70 centímetros, que es un valor un poco alto para los reportados aquí.

**CANDIL** (*Holocentrus ascensionis*): Esta especie es reportada sólo para el segundo crucero y fue capturada desde los 15 cm, con una talla modal en el rango de los 21-23 centímetros (Figura 33).

La FAO reporta tallas hasta 25 centímetros, cifra que está muy cercana a lo reportado.

**MOJARRA RAYADA** (*Eugerres plumieri*): Esta especie es reportada sólo para el segundo crucero. Se presentan capturas desde los 10 centímetros, con una talla modal en el rango de los 13-15 centímetros (Figura 34).

La FAO reporta una talla común hasta 25 centímetros, que está dentro de las tallas reportadas para este crucero.

**PAGUARA** (*Chaetodipterus faber*): Solamente se reportan tallas para el segundo crucero, con capturas desde los 15 centímetros y una talla modal en el rango de los 15-17 centímetros (Figura 35).

La FAO reporta tallas comunes hasta 40 centímetros. Este valor está alejado de la talla modal reportada en este crucero.

## 5.2 ANÁLISIS DE TALLAS PARA LAS ESPECIES CAPTURADAS EN EL PACÍFICO

**PARGO LUNAREJO** (*Lutjanus guttatus*): En el primer crucero se reportan tallas desde los 13 centímetros, con una talla modal en el rango de los 31 – 33 centímetros (Figura 36).

En el segundo crucero también se reportan capturas desde los 13 centímetros, con una talla modal en el rango de los 28-30 centímetros (Figura 37).

La FAO reporta talla máxima de 80 centímetros, mientras que en ésta investigación la máxima talla reportada fue de 42 centímetros.

**SIERRA** (*Scomberomorus sierra*): En el primer crucero se reportan capturas desde los 19 centímetros, con una talla modal en el rango de los 25-27 centímetros (Figura 38).

En el segundo crucero la situación es muy similar, la talla inicial es de 19 centímetros, con una talla modal en el rango de los 25-27 centímetros (Figura 39).

La FAO reporta tallas comunes hasta de 60 centímetros, con una talla de primera madurez sexual entre 26 y 32 centímetros, esta última corresponde al grupo de talla modal.

**BARBETA AMARILLA** (*Polydactylus opercularis*): En el primer crucero se reportan tallas desde los 10 centímetros y se distinguen dos grupos, uno con una talla modal en el rango de los 16-18 centímetros y otro en el rango de los 28-30 centímetros (Figura 40).

En el segundo crucero el comportamiento es muy similar. En este caso también se observan dos grupos, uno con una talla modal en el rango de los 16-18 centímetros y otro con talla modal en el rango de los 28-30 centímetros (Figura 41).

La FAO reporta una talla máxima de 40 centímetros, que supera el valor de la talla reportada como máxima de 33 centímetros para este trabajo.

**ESPEJUELO** (*Selene brevoortii*): En el primer crucero se reportan tallas desde los 10 centímetros y se visualizan también dos grupos, el primero con una talla modal en el rango de los 13-15 centímetros y el segundo en el rango de los 28-30 centímetros (Figura.42).

En el segundo crucero las capturas se inician a los 10 centímetros, con una talla modal en el rango de los 13-15 centímetros (Figura 43).

La FAO reporta tallas comunes hasta los 25 centímetros. Este valor está incluido dentro de los rangos observados en este trabajo.

**CAJERO** (*Larimus acclivis*): Sólo se reporta durante el primer crucero, con una talla inicial de captura de 10 centímetros y una talla modal en el rango de los 10-12 centímetros (Figura 44).

La FAO reporta una talla máxima de 26 centímetros. Este valor se encuentra dentro de las tallas reportadas en este estudio.

**BARBINCHE** (*Bagre panamensis*): En el primer crucero se reportan tallas de captura desde los 10 centímetros, con una talla modal en el rango de los 13-15 centímetros (Figura 45).

En el segundo crucero se reportan tallas similares, con una inicial de 10 centímetros y una talla modal en el rango de los 13-15 centímetros (Figura 46).

La FAO reporta una talla máxima de 38 centímetros, que está ligeramente por encima de la máxima reportada en este estudio.

## 5.3 ANÁLISIS DE LOS RESULTADOS DE LAS CAPTURAS

### 5.3.1 Análisis Atlántico

Con el fin de evaluar el comportamiento de las capturas y si éstas se ven influidas por algún tipo de parámetro ya mencionado, y plantear posibles soluciones en la administración de la pesca, se plantearon las siguientes hipótesis:

Ho: el promedio de las capturas es igual para cualquiera de las motonaves.
Ha: el promedio de capturas es diferente para cada una de las motonaves.

Ho: el promedio de las capturas es igual para todas las horas de pesca de la faena.
Ha: el promedio de las capturas es diferente entre las horas de pesca del día.

Ho: el promedio de las capturas es igual para todos los días de las faenas de pesca.
Ha: el promedio de las capturas es diferente para cada uno de los días de las faenas de pesca.

Ho: las diferencias entre las capturas entre las dos motonaves de la investigación son independientes de la hora de pesca o la diferencia entre las horas del día y las motonaves es independiente.
Ha: las diferencias entre las capturas y las motonaves no son independientes.

Ho: las diferencias entre las capturas medias entre las dos motonaves son independientes de la fecha de las faenas de pesca ó las diferencias entre las fechas de las faenas de pesca son independientes a las dos motonaves.

Ha: las diferencias de las capturas y las fechas de las faenas de pesca no son independientes.

Ho: las diferencias de las capturas medias entre las horas del día y las fechas de las faenas son independientes ó las fechas de las faenas de pesca son independientes de la hora del día.
Ha: las diferencias de las capturas entre la fecha y la hora del día no son independientes.

Ho: las diferencias entre las capturas medias de las dos embarcaciones son independientes respecto a los otros dos factores.
Ha: las diferencias entre las capturas medias de las dos embarcaciones no son independientes de los otros dos factores.

Los resultados son los siguientes:

| EFECTO EN LA HIPÓTESIS | F CALCULADO | F CRITICO | CONCLUSIÓN | PROBABILIDAD |
|---|---|---|---|---|
| 1. Motonave (A) | No concluyente | | | |
| 2. Hora (B) | 0.388 | | Aceptado | P > 0.5 |
| 3. fecha (C) | 0.437 | | Aceptado | P > 0.5 |
| 4. A x B | No concluyente | | | |
| 5. A x C | No concluyente | | | |
| 6. B x C | 0.156 | | Aceptado | P > 0.5 |
| 7. A x B x C | No concluyente | | | |

### 5.3.2 Análisis Pacífico

En esta región de la investigación se plantearon las siguientes hipótesis:

Ho: los promedios de las capturas son iguales para las zonas de pesca.
Ha: los promedios de las capturas son diferentes para cada zona de pesca.

Ho: los promedios de las capturas son iguales para las horas de las faenas de pesca.
Ha: los promedios de las capturas son diferentes para cada hora de las faenas de pesca.

Ho: las diferencias en los promedios de las capturas de cada zona de pesca son independientes de la hora de las faenas de pesca ó las diferencias entre los promedios de las capturas de cada hora de la faena de pesca y las zonas son independientes.
Ha: las diferencias entre los promedios de las capturas entre la hora de la faena de pesca y la zona son dependientes.

Los resultados son los siguientes:

| EFECTO DE LA HIPÓTESIS | F CALCULADO | F CRITICO | CONCLUSIÓN | PROBABILIDAD |
|---|---|---|---|---|
| 1. Zona de pesca (A) | 0.691 | | Aceptado | P > 0.5 |
| 2. Hora de pesca (B) | 0.587 | | Aceptado | P > 0.5 |
| 3. A x B | 0.354 | | Aceptado | P > 0.5 |

## 5.4 CAPTURA ESFUERZO Y CAPTURA POR UNIDAD DE ESFUERZO EN EL ATLÁNTICO

Los resultados de los cruceros de investigación muestran que el recurso con más altos índices de capturas es el camarón con el 17%. Aunque las capturas en el primer crucero fueron 0, el pargo con el 9,75%, el bagre con 7,63%, la perla con 6,97%, la raya espinosa con el 6,46%, la raya con el 5,11% y el calamar y la mojarra con el 3% como los recursos más capturados.

Las otras especies no reportan valores al 2,5%, es más, la gran mayoría de éstas no llegan a representar el 1%. Estos valores muestran que la abundancia de los recursos es bastante baja, aunque sería necesario compararla con otras épocas del año.

Es también resulta evidente que los recursos bentónicos, como los lenguados, tienen los porcentajes de capturas más bajas. El porcentaje de captura para *Achiurus achiurus* escasamente representa el 0,02%. Lo que sí es destacable es que los peses representa la mayor cantidad de especie y recursos de invertebrados, aparte de los camarones y el calamar, no aparecen con el más mínimo registro.

Si se observa con detenimiento el comportamiento de las capturas por unidad de esfuerzo (CPUE), se evidencia que el comportamiento es muy similar al de las capturas, lo cual indica que en este caso específico existe una relación entre lo capturado y el parámetro más real de comportamiento de los recursos como lo es el CPUE.

## 5.5 CAPTURA ESFUERZO Y CAPTURA POR UNIDAD DE ESFUERZO EN EL PACÍFICO.

Si descontamos la basura, que muestra un registro muy alto debido a las condiciones medioambientales del Pacífico, que propician este tipo de desechos orgánicos, tenemos que los más altos porcentajes de las capturas fueron para las jaibas con 7,61%, la barbeta con 5,41%, el espejuelo y el pez huevo con 5,05%, la carduma con 4,06%, la sardina 3,97% y el camarón tití con 3,3%.

Los recursos de menores abundancias, sin contar los pelágicos ya que obviamente estos no deben figurar en la pesca de arrastre de fondo, pertenecen a las los crustáceos tipo squillas y algunos peces de plataforma, como los pertenecientes a la familia Sciaenidae. Como en el Atlántico, los invertebrados - excepto crustáceos decapados, calamar y caracol - no figuran dentro de las capturas realizadas por estos embarques.

Al igual que en el Atlántico, la CPUE es también muy representativa de las capturas, indicando que las abundancias de los recursos están representadas por las capturas reales.

## 5.6 ANÁLISIS DE CONTENIDO ESTOMACAL

Desdichadamente, en los cruceros realizados, sólo se han obtenido datos de estómagos del Pacífico se espera obtener muestras del Atlántico.

Los resultados de los análisis estomacales muestran que el ñato y el pargo posiblemente se encuentren en sus áreas de alimentación. Por el contrario, tanto la barbeta como la pelada muestran estómagos vacíos, posiblemente por no encontrarse en su área de alimentación o por encontrarse en proceso de migración o de reproducción.

Se espera completar mejor la información para efectuar análisis un poco más puntuales sobre ésta estructura en las cadenas alimenticias. Éste aspecto se considera uno de los importantes dentro de cualquier estrategia establecida para definir sobre el manejo de los recursos.

**RESULTADO ANÁLISIS CONTENIDO ESTOMACAL**

**ÁREA: PACÍFICO**

| ESPECIE | CONTENIDO | PORCENTAJE (%) |
|---|---|---|
| ÑATO | Penaeus | 14,3 |
| | Squillidae | 21,4 |
| | Restos de camarones | 14,3 |
| | Otros crustáceos | 14,3 |
| | Peces digeridos | 28,6 |
| | Escamas Ctenoideas | 0 |
| | Restos de moluscos | 7,1 |

| ESPECIE | CONTENIDO | PORCENTAJE (%) |
|---|---|---|
| PARGO LUNAREJO | *Pomacanthus zonipectus* | 10 |
| | Sicioniidae | 30 |
| | Clupeidos | 10 |
| | Arideae | 10 |
| | Peces digeridos | 40 |
| BARBETA AMARILLA | Vacíos | 20,7 |
| | Clupeidae | 6,19 |
| | Molusco | 3,4 |
| | Squillidae | 3,4 |
| | Sicioniidae | 13 |
| | Restos de crustáceos | 20,7 |
| | Penaeus | 27,6 |
| | Microgobius | 3,4 |
| | Escamas cicloideas | Presentes |
| PELADA | Vacíos | 35,3 |
| | Clupeidos | 5,9 |
| | Peces digeridos | 23,5 |
| | Restos orgánicos | 0 |
| | Restos de crustáceos | 11,8 |
| | Restos de peces | 23,5 |

**BIBLIOGRAFÍA**

DÍAZ, J.; VELASCO, C. y RAMÍREZ, A. 1998. Monitoreo de la pesquería del camarón de aguas someras del Pacífico Colombiano en 1997. INPA – Buenaventura. Informe Técnico, p. 32 INPA, Buenaventura.

FAO "Guía para la identificación de especies para los fines de la pesca" Pacífico Centro-Oriental, Roma 1995.

FAO "Guía de campo de las especies comerciales marinas y de aguas salobres de la costa septentrional de Sur América" Roma 1992.

INDERENA- MINAGRICULTURA-FAO-DNP. "Bases para un plan de desarrollo del subsector pesquero colombiano". Inderena-Bogotá. 1978.

INPA. "Estudio biológico pesquero de las principales familias que conforman la pesca blanca en el Pacífico colombiano". Contrato 132-94-97. INPA-COLCIENCIAS. Informe Técnico, p. 6. Bogotá. 1997.

MADRID, N. 1997. Evaluación del camarón de aguas profundas en el Pacífico Colombiano. Inf. Téc, abril a diciembre 1995. INPA-Buenaventura.

MOJICA, H.O. 1992. La pesquería de pequeños pelágicos en el Pacífico Colombiano. INPA. Inf. Téc. Bogotá.

PORTILLA, E. 1999. Captura por Unidad de Esfuerzo, tallas promedios y madurez del camarón blanco (*Pennaeus occidentalis*) y titi (*Xiphopennaeus riveti*) en la Ensenada de Tumaco en la post-veda de febrero de 1999. INPA. Tumaco.

POLO, G.; BARRETO, C. y MORA, O. 1990. Ensayo bioeconómico para la evaluación del camarón blanco y la flota pesquera industrial en la costa del Pacífico Colombiano. Inf. Téc. INPA-COLCIENCIAS- Bogotá.

POLO, G. 1989. Fundamentos de mercadeo pesquero. Universidad Pedagógica y Tecnológica de Colombia, Tunja (Boyacá).

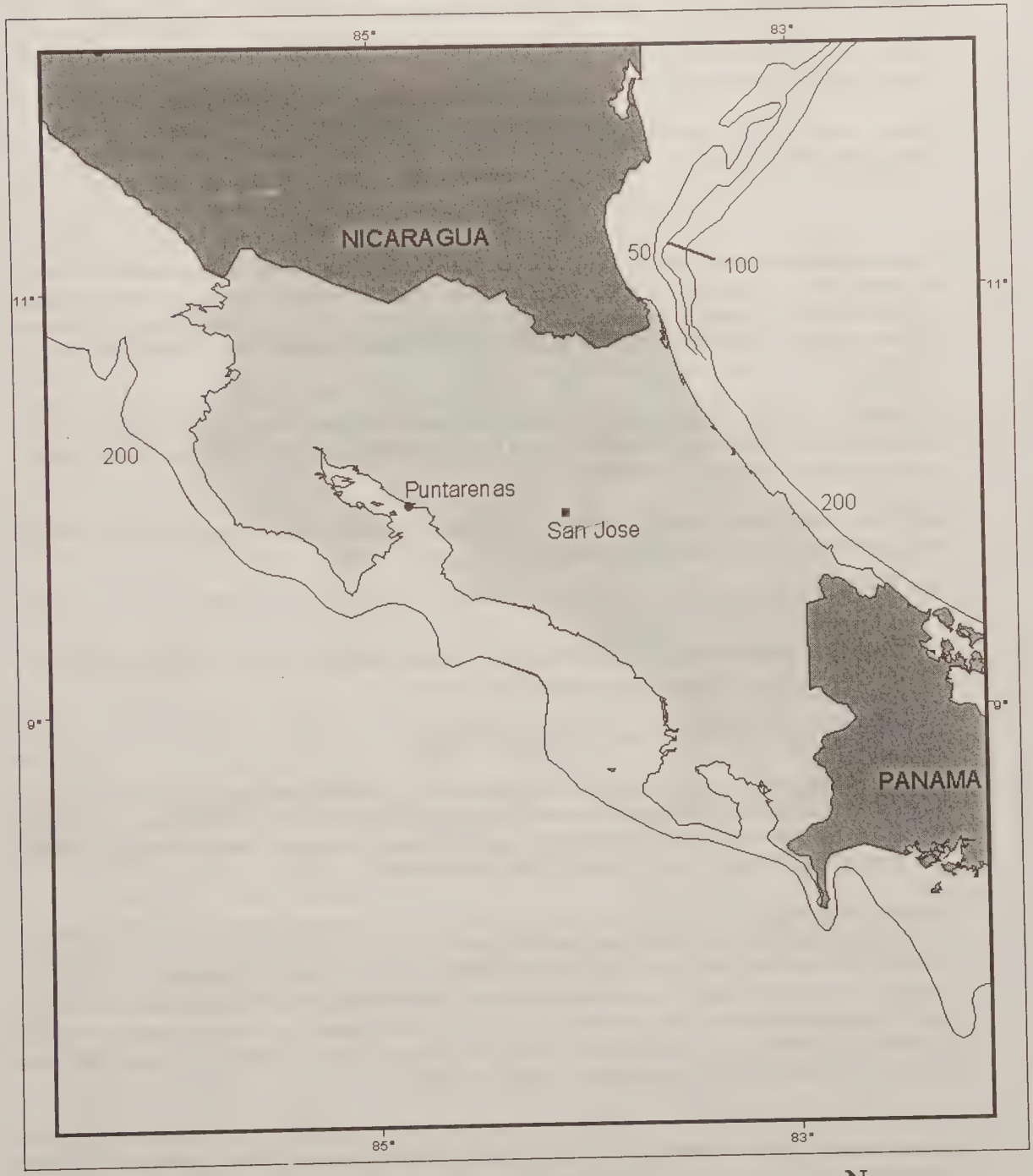
RICCI, O.L. 1997. Crucero de pesca experimental de plumuda. INPA/PEC-PELAG 9610, Informe técnico final. 14 pág. Buenaventura.

RICCI, O.L. 1998. Monitoreo del Recurso Carduma (*Centengraulis mysticetus*) en el Pacífico Colombiano. Inf.Téc. Enero – junio, 1998. INPA- Buenaventura.

ZAPATA, L.; RODRÍGUEZ, G.; BELTRÁN, B.; ÁVILA, R.; CEDIEL, A.; GÓMEZ, G. y HERNÁNDEZ, C. 1997. Crucero de evaluación de recursos demersales por el método de área barrida en el Pacífico Colombiano. Informe Técnico final. INPA-VECEP-CE-ALA/92/43. Buenaventura-Colombia.

## COSTA RICA

**LA PESCA DE ARRASTRE DEL CAMARON EN COSTA RICA Y EL IMPACTO SOBRE EL AMBIENTE MARINO:** The contribution of Costa Rica consists in three parts: A first one is a general overview of the situation of the shrimp fishery in the country: Shrimp fishing fleet, quantities landed, bycatch, fish utilization, management of the fishery, related research. The second and third documents concern the perception of the bycatch related problems by the industry and its attitude and disposal for changing fishing practices.



Abstract

The average annual catch of shrimp (almost entirely from the Pacific) for the last five years, has been about 1 800 t, mainly pink shrimps (*Penaeus notialis*), caught by a fleet including about 73 licenced large outrigger trawlers.

The mesh size in the codend should be at least 37.5 mm and the shrimp trawlers are supposed to use Turtle Excluder Devices.

The shrimp to bycatch ratio is about 1:7.5. Around 2 400 t are discarded per year but by-catch is also landed for the local markets.

There is some general concern in the country about overfishing of the resources and the high. discard rates, particularly of juveniles.

Resumen

Durante los últimos cinco años, la captura promedio anual de camarón (casi totalmente del Pacífico) se ha mantenido alrededor de las 1.800 toneladas métricas. La principal especie, el camarón rosado (*Penaeus notialis*), se captura mediante la flota permisada que incluye unos 73 arrastreros con tangones de gran tamaño. Estas embarcaciones utilizan redes de copo de 37,5 mm y se supone emplean dispositivos exclusores de tortugas (TED).

La relación entre camarón capturado y fauna de acompañamiento es de 1:7,5. Alrededor de unas 2.400 toneladas métricas son descartadas cada año, sin embargo, también se desembarca fauna de acompañamiento en los mercados locales.

En el país existe una preocupación general con relación a la sobre pesca de los recursos y la elevada tasa de descartes, particularmente de juveniles.

## I. LAS PESCAS DE CAMARONES EN COSTA RICA

por Ricardo Gutierrez, Instituto Costarricense de Pesca y Acuacultura (INCOPESCA)

### 1. La flota camaronera de arrastre semiindustrial.

Está compuesta por 73 barcos de los cuales 61 tienen licencia para faenar en aguas someras (80 brazas o menos) y los restantes 12 sólo para aguas de mayor profundidad. What are the different requirements in term of vessel characteristics for getting licences for fishing less than 80 fathom depth or offshore? Any specific justification for the 80 fathom, 150m, depth limit?

La edad promedio de la flota es de 20 años y la potencia de los motores se encuentra en un rango de 126,7 a 372,8 Kw., con una moda y un promedio de 272 kw. Los artes de pesca constan de dos redes laterales y una pequeña de prueba. Las dimensiones de las redes han sido limitadas por Ley, así la abertura máxima horizontal de la boca de cada red no puede ser mayor a 24 m entre calón y calón, la luz de malla mínima para las alas y el cuerpo de las redes de los barcos que faenan en aguas someras es de 50 mm y de 44mm para aquellos que lo hacen en aguas profundas, en ambos casos la luz de malla mínima en la bolsa de la red debe ser igual o superior a los 37,5 mm.

En términos generales la duración de los viajes de pesca es por término medio tres semanas y todos utilizan freón en sus sistemas para la preservación de las capturas. Otras facilidades incluyen ecosondas y sistemas modernos de comunicación tales como radios y teléfonos celulares.

Estudios de principios de los años 80 señalaban que los barcos regresaban a puerto con un 48% de sus bodegas vacías, reportes más actualizados hechos en el 99-2000 indican que esta capacidad de bodega no utilizada ha llegado al 78%. En la mayoría de los casos y gracias a los sistemas de comunicación, el camarón es desembarcado y llevado a las plantas de proceso y empaque casi inmediatamente después

del arribo del barco, el destino principal de este recurso es los Estados Unidos aunque también gran parte de él se dedica al mercado local. El pescado, calamar y otros componentes de la fauna acompañante se dedican exclusivamente al mercado local.

**2. Los desembarques:**

2.1 Desembarques de las flotas nacionales (artesanal y semiindustrial)

| AÑOS | Flota Artesanal (TM) | Flota semiindustrial (TM) | Total (TM) |
|---|---|---|---|
| 1991 | 10035,4 | 1617,9 | 11653,3 |
| 1992 | 9388,3 | 2590,8 | 11979,1 |
| 1993 | 9367,5 | 2453,9 | 11821,4 |
| 1994 | 9678,7 | 2653,4 | 12332,1 |
| 1995 | 10202,8 | 2539,7 | 12742,5 |
| 1996 | 12783,2 | 2409,4 | 15192,6 |
| 1997 | 16766,4 | 2215,5 | 18981,9 |
| 1998 | 13848,1 | 1942,2 | 15790,3 |

2.2 Desembarques de las especies de camarón por parte de la flota semiindustrial. (TM)

| Especie* | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | Totales |
|---|---|---|---|---|---|---|---|---|---|
| **Blancos** | 100,2 | 57,9 | 80,6 | 58,3 | 162,1 | 210,8 | 204,5 | 174,9 | 1049,3 |
| **Café** | 4,2 | 8,9 | 6,0 | 3,9 | 4,2 | 2,6 | 0,7 | 5,9 | 36,4 |
| **Rosado** | 498,3 | 570,1 | 487,2 | 512,9 | 262,2 | 203,7 | 195,6 | 137,8 | 2867,8 |
| **Tití** | 151,9 | 188,8 | 267,4 | 171,6 | 269,2 | 285,4 | 157,0 | 289,5 | 1780,8 |
| **Fidel** | 90,5 | 138,4 | 256,0 | 959,8 | 954,8 | 540,4 | 338,9 | 149,0 | 3427,8 |
| **Camello** | 29,7 | 142,4 | 592,4 | 291,6 | 238,7 | 539,1 | 422,9 | 177,4 | 2434,2 |
| **Real** | 176,5 | 249,4 | 251,3 | 216,8 | 100,2 | 140,5 | 172,1 | 187,5 | 1494.3 |
| **Totales** | 1051,3 | 1355,9 | 1940,9 | 2214,9 | 1991,4 | 1922,5 | 1491,7 | 1122 | 13090,6 |

*Nombres comunes cuyos nombres científicos son los siguientes: **Blancos**: *Penaeus stylirostris*, *P. occidentalis*, *P. vannamei*; **Café**: *P. californiensis*; **Rosado**: *P. brevirrostris*; **Tití**: *Xiphopenaeus riveti*; **Fidel**: *Solenocera agasszi*;**Camello** y **Real**: *Heterocarpus sp*,

| por la flota semiindustrial | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| % of fish to the total | 35 | 48 | 21 | 16.5 | 22 | 20 | 33 | 42 |

Resulta necesario, con el propósito de conocer mejor la pesquería, expresar los resultados anteriores en términos de rendimiento, es decir el comportamiento promedio anual de la captura por esfuerzo de pesca (Kg/hr). Esta información se presenta en el siguiente cuadro.

| Especie | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | Tasa |
|---|---|---|---|---|---|---|---|---|---|
| **Blanco** | 1.17 | 1.04 | 1.17 | 0.96 | 1.60 | 1.71 | 1.50 | 1.40 | 2.26 |
| **Café** | 1.64 | 1.52 | 1.60 | 1.41 | 1.23 | .84 | 0.79 | 1.09 | -4.97 |
| **Rosado** | 6.96 | 6.49 | 6.24 | 5.69 | 5.13 | 4.80 | 3.53 | 2.83 | -10.63 |
| **Fidel** | 6.01 | 5.15 | 6.08 | 9.97 | 9.67 | 7.58 | 5.63 | 3.43 | -6.77 |
| **Camello** | 8.48 | 60.80 | 47.01 | 57.38 | 55.04 | 73.72 | 46.87 | 14.23 | 6.68 |
| **Real** | 21.94 | 29.07 | 15.18 | 21.07 | 19.59 | 17.13 | 20.77 | 21.06 | -0.51 |
| **Tití** | 2.79 | 3.60 | 3.65 | 3.79 | 3.36 | 3.43 | 1.97 | 2.70 | -0.40 |

2.3 Desembarques de fauna acompañante por parte de la flota semiindustrial (TM)

| Categoría comercial | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| Pescado eviscerado | 540,4 | 711,8 | 499,3 | 432,1 | 536,4 | 480,5 | 714,1 | 803,6 |
| Tiburones | 25,8 | 27,2 | 13,2 | 6,1 | 6,6 | 5,8 | 9,6 | 15,8 |
| Langosta | 0,05 | 0 | 0 | 0,03 | 0 | 0,03 | 0 | 0 |
| Calamar | 0,3 | 0,04 | 0,7 | 0,1 | 4,9 | 0,7 | 0,2 | 0,2 |
| **Totales** | 566,6 | 739,0 | 513,2 | 438,3 | 547,9 | 487,0 | 723,9 | 819,6 |

## 3. Distribucion/mercadeo de las pescas de la flota de pesca de camarón

La totalidad de estos desembarques son destinados al consumo humano nacional, por lo general los dueños de barcos los venden a intermediarios quienes son dueños de pescaderías, o bien éstos a su vez la revenden a dueños de pescaderías, restaurantes o instituciones estatales. No existen aún lonjas de pescado, de tal forma que las transacciones se hacen individualmente por teléfono o personalmente.

Con relación a la fauna acompañante sin valor comercial, es decir la que no se desembarca porque se tira al mar, se han realizado estimados que la ubican entre 4500 y 2500 toneladas anuales por parte de la flota camaronera; dependiendo de los autores y el año en que fueron hechas las estimaciones..

Según Campos (1986) el 79% de la fauna descartada correspondía a peces, cuando estos tenían menos de 20 cm de longitud total. Este mismo autor reportó que los barcos descartaban aproximadamente 3 toneladas por viaje of about three week duration, lo cual lo llevó a estimar los descartes totales de la flota en 4.000- 4.500 toneladas métricas por año. Posteriormente, Gutiérrez (1998) encontró que en las pesquerías de aguas someras (less than 80 fathom depth), es decir aquellas que se realizan a 80 o menos brazas y que en realidad producen casi la totalidad de fauna acompañante, la relación camarón:faca descartable presentaba una relación de 1: 6,73, lo cual equivaldría a 2. 437 TM.

## 4. Manejo de las pesquerías

Existen zonas vedadas permanentemente para la pesca de arrastre semiindustrial, tales como estuarios, frente a parques nacionales y frente a zonas de anidamiento masivo de tortugas marinas. Así también se han establecido vedas temporales para camarones de aguas someras durante 5 meses al año en el Golfo de Nicoya. Actualmente se realizan estudios para determinar épocas de desove y reclutamiento en todo el Pacífico, de tal forma que en muy corto tiempo se establecerán vedas en otras regiones del Pacífico con la intención de mantener o aumentar las biomasas explotables.

Los camarones blancos, rosado y titi, se distribuyen en el Pacífico Central y Sur y son capturados durante todo el año. El camarón fidel se distribuye por todo el litoral Pacífico a profundidades cercanas a los 100 metros. Los pandálidos también se distribuyen por todo el Litoral pero a profundidades aún mayores que pueden llegar a las 600 brazas.

Aunque los datos aportados en esta oportunidad, no lo reflejan, análisis históricos con períodos de tiempo más largos, indican sin lugar a dudas, que la situación del recurso camaronero es crítica, misma que ha sido provocada no sólo por fenómenos ambientales tales como el Niño y la Niña, sino principalmente por un sobre dimensionamiento de la flota, así como otras causas atribuibles a la estructura gubernamental que incluye un marco legal obsoleto el deterioro ambiental, el creciente aumento en los insumos y el creciente esfuerzo de la flota artesanal en los estuarios, entre otras. A todo lo anterior se une la insuficiencia de recursos estatales para velar por el cumplimiento de las regulaciones legales.

Así las cosas, se desprende de lo anterior, que las prácticas de manejo han sido insuficientes y por tanto, si el país desea mantener esta flota, se requiere un cambio profundo de las prácticas actuales de ordenamiento pesquero.

## 5. Investigación pesquera

A lo largo de los se han realizado numerosas investigaciones sobre los recursos pesqueros, realizadas fundamentalmente por las dos universidades estatales más grandes, así como por biólogos de la autoridad nacional pesquera (INCOPESCA), organismos internacionales como la FAO y prospecciones de países amigos. Desafortunadamente en no pocos casos las investigaciones persiguieron un objetivo académico más que práctico, de ahí que muchas de ellas no sean útiles de momento para un manejo pesquero. En otros casos, sobre todo en aquellos que compete a los recursos costeros y estuarinos, las investigaciones han servido como elementos importantes para determinar las muchas regulaciones protectoras tales como vedas y artes más selectivos, aplicados fundamentalmente a camarones blancos, langostas, jaibas, tortugas, gasterópodos y otros. Han existido también estudios importantes realizados por organismos internacionales tales como la FAO y PRADEPESCA cuyas recomendaciones han podido implementarse parcialmente, o han sido aprovechadas únicamente por un segmento pequeño del sector pesquero. Actualmente se realizan esfuerzos para unificar y direccionar la capacidad investigativa nacional hacia aspectos relevantes y prácticos, tanto en el campo de la biología pesquera, como en la acuacultura, la calidad del ambiente marino y la tecnología de alimentos, desafortunadamente, los resultados de estos primeros esfuerzos unificadores se podrán ver sólo en el mediano y largo plazo.

## 6 Impacto en recursos: camarón, pescado, no-pescado de la fauna de acompañamiento; impacto sobre los habitates del fondo.

Con relación al impacto de la flota arrastrera sobre el bentos y los organismos que en él habitan no se conoce prácticamente nada. Existe un estudio importante realizado en el Pacífico Sur con la ayuda del barco R/V Victor Hensen, 1993-94, no obstante, resulta muy difícil, por no decir imposible, obtener de él elementos que permitan determinar el impacto de la flota arrastrera sobre el ventos.

## 7. Implicación socio-económica hacia un cambio de técnicas y prácticas que respeten màs el medio ambiente.

El impacto socio-económico que puedan tener nuevas artes de pesca para la flota arrastrera, es algo que aún está por determinarse. No obstante en un plano meramente especulativo, resulta lógico suponer que a mediano y largo plazo estas traerán beneficios importantes, no sólo porque con ellas se estaría logrando una mayor armonía entre los subsectores artesanal y semiindustrial, que ahora compiten por algunos recursos (peces de interés comercial), sino también porque a la vez se estaría favoreciendo una recuperación de tales recursos al trabajar con redes más selectivas, que permitan a los peces pequeños crecer hasta sus tallas comerciales. Además de lo anterior, el beneficio sería aún más grande si las nuevas tecnologías permitieran el ahorro en combustibles y a la vez, no se diera una disminución importante de las capturas de camarón y fauna aprovechable. Si estas condiciones no se dieran, la consecuencia esperable será que los barcos menos eficientes saldrían de la pesquería, por cuanto verían disminuidos sus ingresos a niveles insoportables económicamente, lo cual socialmente traería consecuencias inmediatas negativas.

## II. POSICIÓN DEL SECTOR CAMARONERO ARRASTRERO CON RELACIÓN A LOS ASPECTOS AMBIENTALES (por Biólogo Berny Enrique Marín Alpkar; Setiembre 1999)

### 1. INTRODUCCIÓN

En este trabajo se presenta la posición de los dueños, o sus representantes, de los barcos de arrastre de camarón locales y los capitanes de tales barcos, en relación con los aspectos ambientales de índole general y en particular a los problemas asociados a la fauna de acompañamiento y sus descartes.

El trabajo está basado en una encuesta realizada a las personas antes mencionadas. Durante la elaboración de las encuestas se trató de obtener las respuestas más verdaderas posibles, que permitieran conocer la posición exacta del sector camaronero arrastrero con respecto al daño que causan al medio ambiente.

En el sector científico, el daño que causa la pesca de arrastre al ambiente marino ya ha sido ampliamente discutido por varios autores, incluendo, a escala nacional, Campos (1984) que encontró que se descartan 4.200 toneladas en esas pesquerías. Por otro lado, Gutiérrez, (comunicación personal, 1999) calculó que se descartan 2.323 toneladas métricas de fauna de acompañamiento por año en el litoral pacífico costarricense y en la zona hasta una profundidad de hasta 50 metros.

Descartar esas cantidades de pescado, crustáceos y moluscos al agua es un gran desperdicio para un país en vías de desarrollo, como lo es Costa Rica, y en donde todavía existe mucha pobreza y principalmente debido a que la pesca artesanal depende mucho de la pesquería de algunas especies que están siendo capturadas y desechadas como juveniles por los arrastreros. El problema se crea ya que, sencillamente, éstos son los mismos peces que iría a capturar el pescador artesanal unos meses después.

Sin embargo, aunque el daño se está realizando, no se sabía si los dueños de barcos arrastreros camaroneros y sus capitanes conocían realmente del daño que están causando al ambiente marino y cual era su posición con respecto al problema, por lo que se realizó esta investigación.

### 2. Materiales y métodos

Primeramente se elaboró una lista con los nombres de los barcos camaroneros, su propietario y el representante, en los casos en que se pudo conseguir la información. La misma se obtuvo en el Departamento de Protección y Registro del Instituto Costarricense de Pesca y Acuacultura (INCOPESCA), y fue complementada con datos suministrados por el Sr. Otto López, del Departamento de Estadística del mismo instituto. Posteriormente, se revisaron los informes de descargas de esos barcos para conocer cuales de ellos estuvieron activos en los meses de junio y julio, y los mismos fueron tomados como la lista oficial de barcos a encuestar. La lista fue confeccionada tomando en cuenta también la ubicación de la compañía, empezando con las empresas situadas en barrio El Carmen y finalizado en la Angostura (anexo 1), con el objetivo de facilitar y maximizar la búsqueda de la entrevista.

A esta lista se le creó una columna llamada fecha, con el objetivo de anotar y documentar las fechas en que se realizaron las entrevistas a los propietarios o representantes de cada embarcación. También se creó otra lista, parecida a la antes descrita, para anotar información referente a los capitanes y sus fechas de entrevista.

Seguidamente se preparó el primer borrador de la encuesta, el cual fue presentado al contratante para su debida aprobación y recomendaciones. Una vez obtenida la información anterior, se preparó la encuesta final a ejecutar. Es importante resaltar que, en las encuestas, se incluyeron algunas preguntas de información general sobre el sector camaronero arrastrero. Dichas preguntas fueron formuladas a fin de evitar entrar directamente en la búsqueda de la información, objetivo de la encuesta. Por tratarse de un tema de alta relevancia para el sector camaronero, entrar al tema en forma tan directa podría ocasionar choque o desconfianza con el entrevistado y evitar el logro de los objetivos: efectuar la entrevista y obtener las mejores respuestas acerca de la percepción que tienen los propietarios y capitanes sobre del tema en estudio. El formato de la encuesta es presentado en el anexo 2.

Se definió que el número de capitanes y armadores de embarcaciones a entrevistar debía ser mayor al 10% de cada uno (Ott, 1988), a fin de dar representatividad a la muestra.

Para realizar la entrevista, se visitaron las oficinas de los propietarios o representantes de cada barco y los muelles de las descargas de los mismos. Fue muy difícil la entrevista a los capitanes, porque llegan a puerto y algunos se van inmediatamente para sus casas pues deben salir nuevamente en dos días. Otros capitanes se quedan a la descarga, pero se van apenas termina la misma y regresan al muelle cuando ya va a salir el barco. Por lo anterior, únicamente se lograron entrevistar el 41% de los capitanes (27 de 66) y con respecto a los propietarios o sus representantes, se entrevistaron el 65,5% (19 de 29).

Cinco de los propietarios eran a su vez capitanes de barco, por lo que, su criterio fue tomado en cuenta en el análisis de ambos grupos.

Se efectuaron análisis estadísticos para conocer si las respuestas de los propietarios y capitanes diferían con respecto a las preguntas sobre: fauna descartada comparada con la captura de camarón, influencia de la pesca de arrastre sobre el ambiente marino, y la influencia de esa pesca sobre otras especies diferentes al camarón. Para tal fin, se realizaron pruebas de hipótesis: diferencias entre las proporciones de 2 poblaciones (Daniel, 1992), la cual se utiliza para justificar la combinación de los resultados de 2 muestras de poblaciones disponibles y llegar a una combinación mancomunada de la proporción común compuesta.. En los tres casos se utilizó un $\alpha$= 0,05 (o sea, un coeficiente de confidencia de l-$\alpha$=95%).

Finalmente, también se efectuó un análisis de la posición del sector arrastrero de profundidad, a fin de determinar si los resultados variaban con respecto a la pesca de arrastre en general. Toda vez que, se conoce que esa pesca produce menos FACA y, por lo tanto, que afecta menos el ambiente marino. Este análisis tomó en cuenta principalmente a los capitanes, porque la mayoría de los dueños o representantes de los barcos camaroneros de WWW ad entrevistados eran a su vez dueños también de barcos de orilla.

## 3. Resultados

### 3.1 Fauna descartada comparada con la captura de camarón

#### 3.1.1 Caso propietarios o sus representantes

El 42,1% de los entrevistados (8 personas), consideran que la biomasa descartada es mayor que la captura total de camarón, mientras que el 31,1% (6 entrevistados), consideran lo contrario. Por otro lado, un 10,5% (2 entrevistados) creen que los descartes son iguales y el otro 15,8% (3 entrevistados) consideran que es variable y depende de aspectos físicos como la zona de pesca, las corrientes y las mareas (ver figura 1).

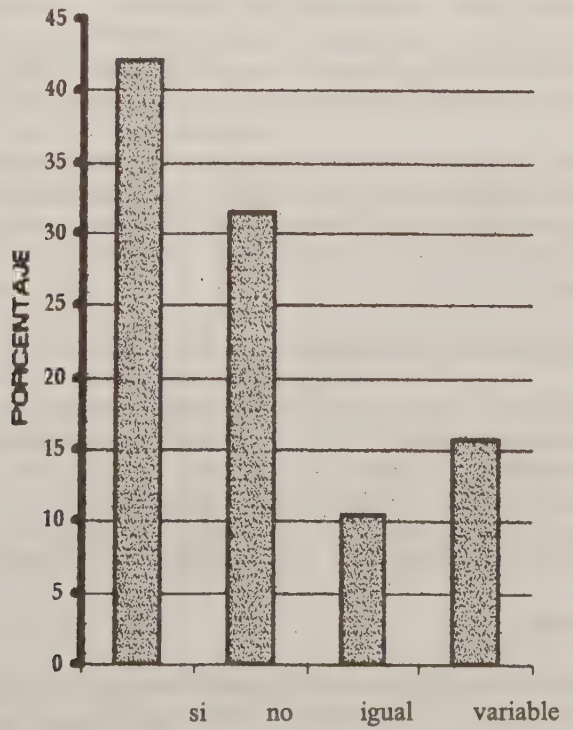



**Figura 1: Respuesta de los propietarios de barcos camaroneros sobre si la cantidad de fauna descartada en la pesca de arrastre es mayor comparada con captura de camarón.**

### 3.1.2 Caso Capitanes

Un 51,9% de los entrevistados (14 personas) contestaron que la FACA descartada no es mayor que las capturas totales del camarón. Mientras que un 37% (10 entrevistados) consideran lo contrario y otro 11,1% (3 entrevistados) opinaron que depende de la zona y otros fenómenos físicos como mareas y corrientes (ver figura 2).

### 3.1.3 Datos agrupados

Un 43,5%(20 entrevistados) consideraron que la FACA descartada no es mayor que las capturas totales de camarón, mientras que un 39,1% (18 entrevistados) opinaron lo contrario, un 4,3% (2 entrevistados) que es igual y un 13% (6 entrevistados) que depende de la zona.

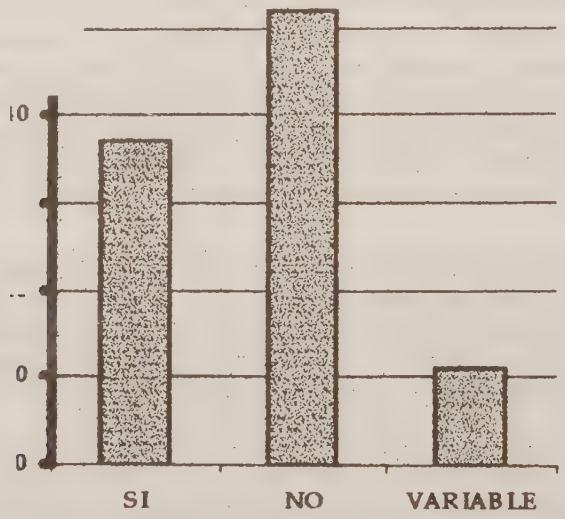



**Figura 2: Respuesta de los capitanes de barcos camaroneros sobre si la cantidad de fauna descartada en la pesca de arrastre es mayor comparada con captura de camarón.**

### 3.1.4 Resultados de las pruebas de hipótesis

Al comparar los resultados de las respuestas de los propietarios, que contestaron que la biomasa descartada es mayor que la captura total de camarón, contra los propietarios que contestaron lo contrario, no se encontró diferencia estadísticamente significativa (Z = 1,539). Sin embargo, al hacer la misma comparación entre los capitanes, los resultados si son estadísticamente diferentes (Z = 2,12).

Al comparar los resultados de las respuestas de los propietarios, que contestaron que si producen más FACA que el camarón capturado, contra los capitanes que contestaron de igual manera, tampoco se encontró diferencia estadísticamente significativa (Z = 0,737). Sin embargo, al hacer la misma comparación entre los propietarios y capitanes que contestaron que no, los resultados son estadísticamente diferentes (Z = 2,91).

### 3.1.5 Caso pesca de arrastre en profundidad

El 14,2% de los entrevistados (1 entrevistado), contestó que la biomasa descartada es mayor que la captura total de camarón, mientras que el 41,9% (3 entrevistados) contestaron lo contrario. También, un 42,9% consideró que la captura de camarón y el descarte de FACA es variable, dependiendo de aspectos físicos como la zona de pesca, las corrientes y las mareas.

## 3.2 INFLUENCIA DE LA PESCA DE ARRASTRE EN EL AMBIENTE MARINO

### 3.2.1 Caso propietarios

Un 84,2% de los propietarios o sus representantes (16 entrevistados) opinaron que esta pesca no afecta el ambiente marino, mientras que el 15,8% restante (3 entrevistados) opina que si lo afectan.

### 3.2.2 Caso Capitanes

Un 74,1% de los entrevistados (20 capitanes) piensan que no afectan el ambiente marino y el 25,9% restante (7 capitanes) opinan que si lo afectan.

### 3.2.3 Datos agrupados

El 78,3% (36 entrevistados) del total encuestado opinan que esta pesca no afecta al ambiente marino, entrevistados. Mientras que el 21,7% restante (10 entrevistados) consideran que si están afectando a este ambiente. Véase figura 3.

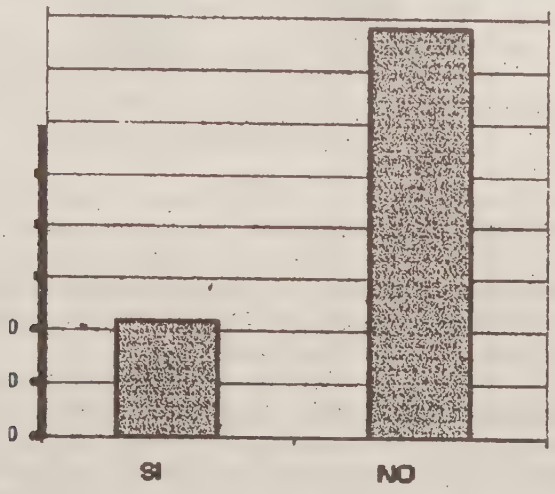



**Figura 3. Respuesta del sector camaronero arrastrero acerca de si la pesca de arrastre afecta el ambiente marino**

### 3.2.4 Caso pesca de arrastre en profundidad

El 42,9% (3 entrevistados) contestaron que la pesca de arrastre, que se realiza en profundidad, si afecta el ambiente marino. Por otro lado, el 57,1% (4 entrevistados) consideran que no lo afectan.

## 3.3 INFLUENCIA DE LA PESCA DE ARRASTRE SOBRE OTRAS ESPECIES DIFERENTES AL CAMARÓN

### 3.3.1 Caso Propietarios o sus representantes

Un 78,9% de los entrevistados (15 dueños) consideró que la pesca de arrastre no afecta a otras especies diferentes del camarón, mientras que un 21,1% (4 propietarios) consideró que si las afecta.

### 3.3.2 Caso Capitanes

El 74,1% de los capitanes (20 entrevistados) consideró que la pesca de arrastre no afecta, mientras que el 25,9% restante (7 entrevistados) consideró que si las afecta.

### 3.3.3 Datos agrupados

Un 76,1% (35 entrevistados) del total de personas entrevistadas considera que no las afecta, mientras que el 23,9% restante (11 entrevistados) consideró que esta pesca si afecta a otras especies. Véase figura 4.

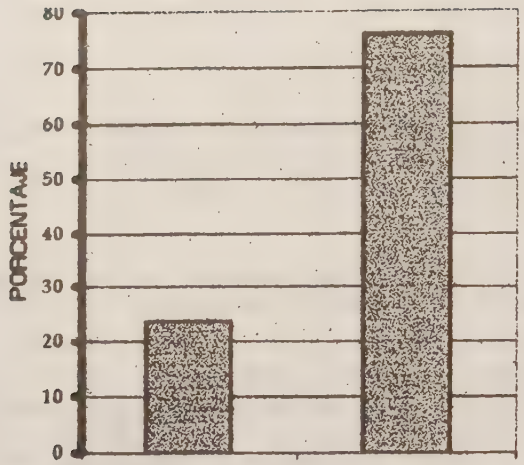



**Figura 4: Respuesta del sector camaronero arrastrero acerca de si la pesca de arrastre afecta a otras especies diferentes del camarón.**

### 3.3.4 Caso pesca de arrastre en profundidad

El 42,9% de los entrevistados (3 personas) contestaron que la pesca de arrastre, que se realiza en profundidad, afecta a otras especies que no son precisamente el camarón. Mientras que el 57,1% restante (4 entrevistados) considera que no las afectan.

## 4. OPCIONES PARA SOLUCIONAR EL PROBLEMA DE LA FACA.

El 95,1% del sector (39 entrevistados) consideró que la solución más viable es procesarla, principalmente en harina de pescado y otros propusieron también fabricar cubitos y consomés concentrados. También se recomendó empacarla y traerla en bolsas pequeñas y venderla para "bocas" en cantinas. Mientras que el 4,9% (2 entrevistados) recomienda devolver la FACA descartable al sitio donde fue capturada. Véase figura 5.

Por otro lado, el 100% de los encuestados se oponen rotundamente a la instalación de dispositivos de exclusión de la FACA.

## 5. PRODUCCIÓN DE FACA POR TIPO DE PESCA Y POR ESTACIÓN

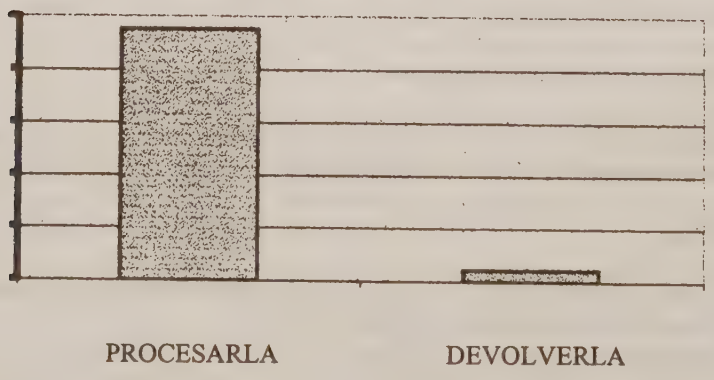



**Figura 5: Soluciones que recomienda el sector camaronero arrastrero para solucionar el problema de la Fauna de acompañamiento.**

Un 80,5% (33 entrevistados) del total de encuestados, opinó que la pesca de camarón blanco y pequeño (de orilla) es el que produce Os FACA. Por otro lado, un 12,1% (5 entrevistados) opinó que se produce más FACA cuando se capturan camarones fidel y rosado. El 2,4% de los entrevistados considera que es

igual (1 entrevistado), mientras que el 4,9% restante (2 entrevistados) considera que es variable y que depende más en la fase lunar, tipo de mareas y temperatura del M, que en el tipo de pesca (Figura 6).

**6. Razones por las cuales se descarta la faca**

El 100% de los entrevistados consideró que la principal razón por la cual se descarta la FACA, es porque no puede ser comercializada. Los entrevistados rechazaron las opciones de respuesta que implicaban descartes de la FACA debidos a la utilización de las bodegas en especies de mayor valor comercial o porque se requiere mucho tiempo para su separación y eviscerado.

**7. Capacidad de almacenaje disponible en los barcos**

En promedio, cuando un barco camaronero llega a puerto, únicamente ocupa el 28,6% de su capacidad. Es decir, tiene un 71,4% de disponibilidad en bodegas para traer FACA.

**8. Discusión**

Primeramente, se debe resaltar que la muestra utilizada fue representativa en cuanto al número de capitanes y armadores entrevistados. Al respecto, Ott (1988) recomienda que se utilice una muestra del 10% de la población, cuando ésta es grande. En este trabajo se entrevistó el 41% de los capitanes y el 65,5% de los propietarios. Esta puede considerarse una muestra buena, si también tomamos en cuenta la dificultad que implica entrevistar a todo el sector camaronero arrastrero.

De las preguntas más importantes efectuadas es esta encuesta, estaba la posición de dueños y capitanes, con respecto a la cantidad de camarón capturada y la FACA que se descartaba, ya que, si opinaban que se descartaba mucha FACA, se podría también considerar que afectan al ambiente marino. Al analizar los resultados de las respuestas de los capitanes, con respecto a lo anterior, podemos concluir que ellos consideran que se captura más camarón que la FACA que se descarta. Esta respuesta llama la atención, ya que, científicamente se conoce que esto no es verdadero, también, los capitanes al pasar más tiempo en las faenas de pesca que los dueños de los barcos, conocen mejor la problemática de la FACA. Este resultado también llama la atención porque un porcentaje mayor de capitanes que dueños, opinan que se captura más camarón, esperándose una respuesta contraria o al menos que se captura parecido, ya que los dueños de los barcos podrían pensar que se verían afectados si se concluye que se descarta mucha FACA.

No se puede concluir claramente en este trabajo, si los dueños de embarcaciones tienen la percepción clara de que descartan más FACA que el camarón total capturado. Porque los porcentajes entre los que contestaron "si" y "no", resultaron parecidos y sus respuestas no fueron estadísticamente diferentes. Sin embargo, se nota cierta incongruencia en las respuestas, lo cual se debe a lo objetivo que pueda ser el entrevistado y a lo subjetivo que pueda ser su respuesta. Por un lado, el pescador puede considerar objetivamente que está capturando mucha FACA, y así responde. Mientras que otro sector puede creer verdaderamente que captura poca FACA o no afecta al ambiente marino, por tres razones: 1. porque lo cree así, 2. porque piensa que podría verse afectado si contesta que está produciendo y botando mucha FACA o afectando al ambiente marino y 3. porque la respuesta puede ser subjetiva debido a la experiencia y conocimientos de cada entrevistado. Por ejemplo, varios entrevistados contestaron que la FACA descartada no era mayor que las capturas de camarón, pero al comparar sus cantidades descargadas de FACA, según las respuestas ofrecidas en la encuesta, se encontró que eran iguales a otros entrevistados que dijeron que la FACA descartada si era mayor que el camarón capturado. Lo difícil es saber cual de los argumentos anteriores hicieron que el entrevistado respondiera de esa manera.

Por otro lado, también se analizaron las capturas de algunos barcos cuyos capitanes o dueños informaron que la FACA descartable era menos que el camarón capturado. Así, se encontró que 4 de los barcos que afirmaron lo anterior, habían producido más FACA que camarón en sus últimos viajes, como se demuestra en la siguiente tabla.

| BARCO (Código Dpto. de Estadística, INCOPESCA) | CAMARÓN CAPTURADO (kilogramos) | DÍAS DE PESCA | FACA PRODUCIDA SEGÚN ENCUESTA |
|---|---|---|---|
| 220385 | 847,5 | 14 | 14 días X 136 kilogramos = 1.904 |
| 220.995 | 420 | 13 | 1.300 kilogramos en 15 días |
| 220775 | 122 | 13 | 1.200 kilogramos en 15 días |
| 220265 | 381 | 15 | 3.500 kilogramos en 15 días |

Fuente: INCOPESCA, I999 y encuestas realizadas para este estudio.

Algunos entrevistados también consideraron que la cantidad de FACA depende de factores tales como la zona de pesca, duración del lance, las corrientes, mareas y fase lunar, lo cual tiene mucha lógica. Así, dentro de las zonas consideradas como más productoras de FACA están los pescaderos del golfo de Nicoya, principalmente frente a Tárcoles, Caldera y Puntarenas, mientras que las zonas como Mantas y Quepos se consideran menos productoras.

Al analizar las respuestas del sector arrastrero de Voldidad, se concluye que tienen la percepción que capturan más camarón que los descartes de FACA efectuados. Este resultado coincide más con las observaciones de los técnicos, ya que la pesca de profundidad se ha caracterizado por ser una pesca más limpia, en donde son extraídas especies como la cabrilla y el congrio de tamaño comercial, aun cuando, en algunas zonas se obtienen cantidades considerables de alacrán marino y una especie de china.

En cuanto a la influencia de la pesca de arrastre en el ambiente marino, el sector camaronero está plenamente convencido que no lo afecta. Esto se puede concluir, al observar los porcentajes de propietarios, capitanes y por ende los datos agrupados: cerca del 80% opina que no lo afecta. Sin embargo, lo que más influye para alcanzar esta conclusión, es la forma en que respondieron los entrevistados a la encuesta, donde en forma determinada y clara manifestaron que no afectan al ambiente marino. Dentro de las razones que manifestaron para sustentar sus respuestas están las siguientes:

1. La pesca ha sido por muchos años sostenible. Ellos aseguran que tienen muchos años de pescar camarón, algunos hasta 30 años y siempre han existido años de buena y años de mala pesca. Además, exponen que en España se ha pescado toda la vida camarón y se sigue pescando.

2. El camarón se "auto veda", desapareciendo por épocas, con lo cual baja el esfuerzo pesquero, hasta que vuelva a crecer la población de camarón.

3. El estado también veda su pesca, cuando los camarones se están reproduciendo, asegurando así las poblaciones futuras.

4. Existe una veda permanente de pesca, mediante arrastre en los criaderos naturales como el interior del golfo de Nicoya y los esteros.

5. La pesca de arrastre, por el contrario, beneficia a otras especies y no existen estudios que demuestren que afectan al camarón y otra especie. Cuando la FACA se tira al agua, los primeros beneficiados son las aves, luego los peces que viven a media agua como las inmensas poblaciones de jureles y también tiburones y finalmente lo que llega al fondo se lo comen los cangrejos, moluscos y langostas. Así aseguran que pescan en una zona varios días, tirando la FACA, pero cada día siguiente no se obtiene nada de la misma en las redes, ya que fue consumida por otras especies. La pregunta que hacen es que son más importantes las especies que pudieran afectar o las que están siendo beneficiadas.

6. La FACA no contamina. Generalmente se le arroja en zonas de aguas profundas y, por lo tanto, con mucho oxígeno. Esto asegura que el pescado que no sea consumido por las aves, peces, cangrejos u otros, se descomponga fácilmente en presencia de oxígeno, porque la FACA biodegradable.

7. Los arrastreros consideran que el problema de la caída de las capturas de camarón concuerda con el inicio de la pesca artesanal de camarones, en el interior del golfo de Nicoya. Indican que la pesquería artesanal no ha sido regulada por el Estado. También manifiestan que los arrastreros no pescaban ahí para protegerlo, pero los artesanales están pescando ahí con mallas muy pequeñas y muchas veces pescando dentro de los mismos esteros. Además, como son tantos los pescadores, ponen los trasmallos a poca distancia el uno del otro, capturando camarones pequeños y grandes, incluyendo los que iban a desovar. Exponen también, que la pesca de arrastreros no afecta tanto como la artesanal, porque al pescar camarón mediante barcos arrastreros, éste al sentirse acosado emigra a zona más profundas. Pero, durante la pesca artesanal del camarón ejecutada en el interior del golfo, no pueden hacer lo mismo, ya que vayan donde vayan, encuentran trasmallos por las concentraciones tan alta de éstos. Finalmente se quejan de que los trasmallos monofilamento son dejados abandonados en el golfo, siendo trampas mortales que capturan permanente camarones sin ser aprovechados.

8. La baja en la pesca del camarón también se debe a la contaminación del los ríos Tempisque y Tárcoles, y a los ingenios.

9. No toda la FACA se desperdicia porque gran parte se aprovecha y de la que se descarta, mucha no muere. Por ejemplo, en pesca de orilla, muchos pescados, cangrejos y moluscos se salvan porque son devueltos vivos al mar. En pesca de aguas profundas los que más se salvan son los cangrejos y moluscos.

10. Cuando se realiza la pesca de arrastre, las redes, tablas y cadenas levantan microorganismos que alimentan a otras especies. Por otro lado, al mover el sedimento levantan nutrientes que han estado ahí retenidos, con lo cual reciclan la energía y hacen más rico el ecosistema.

11. Hoy día ha bajado más del 30% la cantidad de FACA capturada ya que el TED permite la salida de tortugas y también de peces grandes.

Con respecto al efecto de la pesca de arrastre sobre otras especies distintas del camarón, nuevamente las respuestas de la mayoría de los encuestados: propietarios, capitanes o por los datos agrupados, permiten concluir que ellos piensan que no afectan a otras especies marinas y sus argumentos son los mismos o parecidos a los presentados anteriormente.

Las otras opciones para procesar la FACA, propuestas en la encuesta, fueron utilizar dispositivos de exclusión o una combinación de procesarla y el dispositivo. Por las respuestas obtenidas, podemos concluir que la mayoría del sector se opone a utilizar dispositivos, ya que argumentan que quebrarían económicamente debido a que el TED les habría bajado bastante sus capturas.

Según los entrevistados, la principal opción para solucionar el problema de la FACA es procesarla en harina de pescado (95,1%) y otras también proponen la fabricación de consomés y cubitos concentrados. Otros recomiendan que se ponga esa fábrica por parte del gobierno y así poder aprovechar la FACA, ya que va ha ser difícil que ellos la pongan por falta de recursos. Esta posibilidad fue complementada con la pregunta acerca del bodegaje vacío de los barcos al final de cada viaje, encontrando que en promedio un 71,4% de las bodegas vienen vacías y podrían ser utilizadas para traer FACA.

El proyecto se ve fortalecido si observamos que un 80,5% de los entrevistados considera que la pesca de orilla produce más FACA y, por tanto, sería más fácil de transportarla por la distancia. Además, en la zona de pesca de profundidad, existe una FACA muy selecta y abundante, como el langostino y el alacrán marino, de los cuales podría producirse algún condimento, elevando así su valor y haciendo más factible su aprovechamiento.

En cuanto a la razón por la cual no se aprovecha la FACA, el argumento principal del sector (100 %) es que la misma no puede ser comercializada. De existir alguna remuneración económica, podrían traerla a puerto para su comercialización y aprovechamiento.

## 9. Recomendaciones

1. Se deben analizar profundamente las respuestas dadas por el sector entrevistado con respecto a su efecto sobre el ambiente marino, ya que algunas de sus respuestas podrían ser válidas y sólo con más investigación será posible demostrar y convencer a este sector de que verdaderamente afectan a ese ambiente.

2. El INCOPESCA debe realizar foros, talles y todo tipo de divulgación y capacitación que permita la toma de conciencia del sector camaronero arrastrero sobre su efecto al ambiente marino. Lo anterior en los campos en que ya se tenga pleno conocimiento y esté demostrado lo antes enunciado. Se considera que se podría obtener mejor información y principalmente una mayor toma de conciencia si se capacita ampliamente a este sector.

3. Se debe analizar seriamente la posibilidad de procesar la FACA, para lo cual existen soluciones factibles y serias. Estas iniciativas deben ser ejecutadas a escala gubernamental, ya que, a la empresa privada se le dificulta resolver el problema que representa la FACA, por los recursos económicos y porque todavía no existe suficientemente conciencia y disposición a hacerlo.

ANNEXE

INSTITUTO COSTARRICENSE
DE PESCA Y ACUACULTURA

**ENCUESTA PARA ARMADORES Y CAPITANES DE BARCOS CAMARONEROS**

Nombre de la Embarcación: Propietario o representante:

Entrevistado: A: Propietario B: Capitán:

1. ¿Qué especies de la FACA están siendo actualmente conservadas y comercializadas?

2. ¿Considera que la biomasa de FACA descartada es mayor que la captura total del camarón?

A: Si B: No

3. ¿Cuánta cantidad de kilogramos considera que se descarta anualmente como FACA:

4. ¿Cuál opción de las siguientes considera que soluciona el problema de la FACA

A: Procesar la FACA. (Si contesta A, entonces ¿Qué fipo de proceso recomienda?)

B: Usar dispositivos de exclusión de la FACA:

C: Una mezcla de A y B.

5. ¿Considera que la pesca de arrastre afecta el ambiente marino?

A: Si B: No (Si contesta que no pase a la pregunta 7.

6. ¿Cómo la afecta?

7. ¿En cual tipo de pesca se produce más FACA?:

A: Camarón blanco y pequeño

B: Camarón rosado y café

8. ¿Cuando se decarta más FACA:

A: En época lluviosa

B: En época seca

9. ¿Considera que la pesca de arrastre afecta otras especies que no son camarón?

A: Si B: No (Si contesta que no pase a la pregunta 11)

10. ¿Como las afecta?

11. ¿Porqué se descarta la FACA?

A.: ¿Para utilizar las bodegas en especies de mayor valor comercial?

B: Por que la FACA no se puede comercializar:

C: Por que toma mucho tiempo separar y eviscerar la FACA.

12. ¿Qué porcentaje de la capacidad de almacenar la pesca en el barco camaronero es utilizado al final del viaje de pesca?:

## III. EVALUACIÓN DE LA PERCEPCIÓN DE LOS CAMBIOS TECNOLÓGICOS Y LA ACTITUD PARA MODIFICAR LAS PRÁCTICAS PESQUERAS (Por M.B.A. Angel Fco. Herrera Ulioa, Biol. Mar., diciembre 1999)

### 1. Introducción

El presente trabajo es una investigación independiente contratada por el Proyecto para la Reducción del Impacto de la Pesca de Arrastre del Camarón sobre la Pesca Incidental y el Ambiente Marino (FAO-INCOPESCA). El propósito del trabajo es evaluar la percepción de los cambios tecnológicos y la actitud para modificar las prácticas pesqueras, en relación con los aspectos sociales y económicos conexos, tanto de los tripulantes como de los armadores. Mediante un estudio del conocimiento de las actitudes y prácticas vigentes de la actividad, así como de las situaciones económicas y sociales de los involucrados directos.

### 2. Metodología

Se escogió al azar una muestra de los barcos que pescan camarón blanco, de dicha muestra accedieron a ser entrevistados un 25% de los representantes de la flota camaronera arrastrera (excluyendo los arrastreros de profundidad): sobre 15 embarcaciónes y varias empresas camaroneras. No fue posible contactar los representantes de dos barcos de la boa, ni y otros dos barcos que habían cambiado o estaban en trámites de cambio de dueño, por lo tanto, las entrevistas correspondientes a estas embarcaciones no fueron efectuadas.

La entrevista consistió en llenar un formulario con preguntas abiertas, las cuales fueron aplicadas al armador, al capitán y a un tripulante cualquiera del barco seleccionado. Cada uno de los formularios tenía variaciones en las preguntas y se diseñaron principalmente para evaluar las percepciones de los entrevistados. La ejecución de las entrevistas a los capitanes y tripulantes fue difícil por la disponibilidad para encontrar al capitán y a la tripulación en tierra, por lo que sólo se aplicó el instrumento a cinco embarcaciones.

Debido a las características del estudio, y por tratarse de una base para estudios posteriores, se decidió manejar la información más en su parte cualitativa que cuantificarla por medio de estadísticas, dado que, este último tipo de manejo provoca la pérdida de muchos comentarios valiosos.

### 3. Resultados

A continuación se indican las respuestas obtenidas, al efectuar las preguntas de los tres tipos de instrumentos (encuestas) aplicados.

#### 3.1 Capitanes

**1. ¿Cuántos días de trabajo promedio requiere para tener una captura comercialmente aceptable?**

El rango de las respuestas estuvo entre los 14 hasta 22 días. Una persona indicó que la empresa establecía como límite 12 días para evitar que el camarón se "quemara" por efecto del frío.

**2. En su opinión ¿Cuáles son los principales problemas ambientales que enfrenta el barco en sus labores diarias? ¿Cuáles son los principales problemas ambientales que produce el barco?**

El 100% de las respuestas se centró en los problemas de basura y troncos, especialmente en el sur del país. No hubo señalamientos sobre los problemas ambientales que el barco podría estar ocasionando.

**3. ¿Cuáles áreas de pesca son las que presentan mayores problemas ambientales?**

Un 100% de los entrevistados señalaron las desembocaduras de los ríos (Tárcoles especialmente), y la zona sur del país: Coronado, Quepos, Parrita, además, un capitán señaló que en el invierno la situación empeora porque las lluvias provocan un mayor arrastre de troncos y otros.

**4. ¿La forma en que se realiza la actividad pesquera ha cambiado con el tiempo? ¿Cómo ha sido ese cambio?**

El 100% de los entrevistados respondió que no han existido cambios en la actividad como tal. Sin embargo, dos capitanes mencionaron que, aunque la rutina es la misma, muchos años atrás las redes eran más pequeñas y debido a que se ha tenido que viajar más lejos, la capacidad de los barcos se ha incrementado. Un capitán mencionó que el TED ha obligado a cambiar la rutina en la faena porque en muchas ocasiones el camarón es aplastado, lo que implica una disminución de su precio. Otro entrevistado mencionó que los cambios se han dado en la disminución del camarón capturado.

**5. ¿La percepción de los daños ambientales ha cambiado con el paso del tiempo?**

A pesar de que en la pregunta 3 se solicita un comentario sobre los daños al ambiente que provocan los barcos, la pregunta fue contestada negativamente por todos los capitanes. Es en ésta pregunta en la que los capitanes hacen referencia al problema ambiental que provocan los barcos camaroneros. Dos capitanes indicaron que la mayoría de las personas, que trabajan en barcos camaroneros, conocen el daño ambiental. Siempre ha sido igual. Otros dos capitanes mencionaron que no se provoca ningún daño al ambiente.

**6. ¿Qué opina del excluidor de tortugas (TED)?**

Dos capitanes mencionaron que no funciona, inclusive, uno de ellos hizo referencia a que antes mataban menos tortugas que en la actualidad. Sin embargo, los otros tres capitanes indican que se debería usar en sitios donde proliferan las tortugas tal como la costa de Guanacaste, pero no en aquellos sitios donde son escasas, como por el ejemplo el sur del país que, además, es uno de los lugares donde se encuentran la mayor cantidad de troncos y palos.

**7. ¿En cuánto económicamente afecta el TED a la empresa?**

Tres entrevistados mencionaron que la afectación es de un 50% y dos que el daño a la empresa es de un 60 %.

**8. ¿Con el pasar de los años antes de que se usara el TED, como percibió usted la cantidad de tortugas que eran atrapadas en la red? ¿aumentaba o disminuía el número?**

Una pregunta con respuestas encontradas, se mencionó: que nunca hubo muchas tortugas muertas, sólo hacia el norte del país. Ahora mueren menos tortugas. Se capturaba igual cantidad pero ahora mueren más tortugas. No caen muchas tortugas, pero cambiaron el tiempo de arrastre a dos horas. Nunca cayeron muchas tortugas y siempre se devolvieron al mar.

**9. ¿Las embarcaciones actuales son eficientes? ¿Cómo podrían ser más eficientes?**

Son eficientes, pero es necesario un buen mantenimiento. Son más eficientes los barcos elaborados en fibra, porque requieren un menor mantenimiento, pero existen sólo cuatro barcos dentro de la flota construido en fibra de vidrio.

**10. ¿Se le han introducido cambios tecnológicos a las embarcaciones en los últimos diez años?**

Se han introducido nuevas tecnologías como el GPS, el radar, la ecosonda de pantalla y, dependiendo de la compañía, hasta teléfonos celulares.

**11. ¿La FACA es un problema? ¿Qué se podría hacer con la FACA?, Si tiene una idea de uso productivo ¿Cómo se podría llevar a la realidad?**

Un capitán mencionó que la FACA es un problema, sugiere que se podrían elaborar embutidos. El resto de los capitanes no lo ven como un problema, sino más bien como un beneficio. Tres de los entrevistados que señalan el beneficio de la FACA, mencionan que el pescado pequeño es desechado, y al menos uno de ellos menciona que se podría elaborar harina si existiese alguna fábrica interesada.

**12. ¿La cantidad de barcos que operan sobre el camarón es la adecuada?**

Tres de los capitanes mencionan que la cantidad de barcos en la zona de operación es excesiva. Otro capitán comentó que la cantidad actual es adecuada. Y otro apeló a la mano de obra que generan y la posibilidad de dejar personas desempleadas si la cantidad se reduce.

3.2 Tripulantes

**1. ¿Cuántos días de trabajo promedio requiere para tener una captura comercialmente aceptable?**

Tres tripulantes indicaron 15 días y uno indicó 12 días.

**2. En su opinión ¿Cuáles son los principales problemas ambientales que enfrenta el barco en sus labores diarias? ¿Cuáles son los principales problemas ambientales que produce el barco?**

Todos señalaron el problema de los troncos y palos que se encuentran al sur. Uno hizo referencia a que algunos barcos contaminaban, dos hicieron observaciones sobre barcos que contaminan. Se mencionó escuetamente el problema de la basura que es recogida por los barcos, especialmente en la boca de los ríos.

**3. ¿Cuáles áreas de pesca son las que presentan mayores problemas ambientales?**

Las desembocaduras de los ríos especialmente el Tárcoles. El Sur, debido a la presencia de troncos y palos.

**4. ¿La forma en que se realiza la actividad pesquera ha cambiado con el tiempo? ¿Cómo ha sido ese cambio?**

Sólo una persona contestó que habían ocurrido cambios, y señaló que las redes en la actualidad son más grandes que hace 15 años atrás. El resto mencionó que no han ocurrido cambios y que la rutina es la misma.

**5. ¿La percepción de los daños ambientales ha cambiado con el paso del tiempo?**

Las repuestas fueron diferentes. Años atrás no se le daba importancia al daño que ocasionaba la pesca sobre la fauna marina. Se mencionó que hoy en día existe una mayor conciencia, pero se sigue haciendo daño. Ha aumentado la contaminación, especialmente en Quepos y Coronado. Pero, un tripulante mencionó que no han habido cambios y que siempre ha sido normal.

**6. ¿Qué opina del excluidor de tortugas (TED)?**

Un tripulante mencionó que evita la mortalidad de tortugas. El resto mencionó que es muy injusto, el camarón se mata o se sale, debido a que el agua es suba y el aro se obstruye o se tuerce. Se matan más tortugas.

**7. ¿En cuánto económicamente afecta el TED a la empresa?**

Las respuestas fueron diferentes, se mencionó que afectaba en un 40 %. En un 50 %, entre un 40% y un 50 %, e inclusive se mencionó que afectaba hasta en un 70%

**8. Con el pasar de los años antes de que se usara el TED, como percibió usted la cantidad de tortugas que eran atrapadas en la red ¿aumentaba o disminuía el número?**

Se atrapan más tortugas con el TED, anteriormente eran menos. La mayoría se devuelven al mar. Muy pocas se ahogan. En el Norte funciona no así en el Sur.

**9. ¿Las embarcaciones actuales son eficientes? ¿Cómo podrían ser más eficientes?**

Dos tripulantes no respondieron la pregunta. Otros dos mencionaron que las embarcaciones actuales son más eficientes, porque, entre otras características, tienen mayor capacidad de almacenamiento de agua y diesel comparadas con otras embarcaciones más viejas.

**10. ¿Se le han introducido cambios tecnológicos a las embarcaciones en los últimos diez años?**

Ecosonda, GPS, teléfono celular fueron mencionado. Alguno mencionó que no han habido cambios en las embarcaciones.

**11. ¿La FACA es un problema? ¿Qué se podría hacer con la FACA? Si tiene una idea de uso productivo ¿Cómo se podría llevar a la realidad?**

Con los camaroneros siempre se ha producido FACA. Tres marineros señalaron que era una solución. Uno mencionó que la pobreza ha hecho que se aproveche casi todo. Es un beneficio para la tripulación. Un tripulante mencionó que es un problema y que se podría aprovechar para hacer harina de pescado

**12. ¿La cantidad de barcos que operan sobre el camarón es la adecuada?**

Un tripulante mencionó que deben quedarse los que están. Otro comentó que al haber desaparecido barcos, deberían ser más. Y dos tripulantes mencionaron que eran ya muchos barcos pescando y deberían ser menos.

### 3.3 Armadores

**1. ¿Cuántos días de trabajo promedio requiere para tener una captura comercialmente aceptable?**

Es difícil contestar, es muy variable, un tanto 13 - 15-20, según la época o según especies (alguno dico que para camarón blanco es no más de 12 días, pero para pinky y fidel de 14 a 15 días)

**2. ¿Se acostumbra hacer una selección de los posibles tripulantes? Si hay selección, como se aplica usualmente y que se requiere conocer del candidato.**

Se escoge al capitán y al maquinista, los demás los escoge el capitán.

Si el barco tiene que salir y no hay tripulación, se contrata al que sea.

Sí. El capitán escoge previo consentimiento del armador.

No. El país no cuenta con una estandarización de trabajadores del mar, no hay regulaciones, sin embargo, se exige que la gente sea limpia, honrada y que no consuma drogas.

No.

Sí. Se piden referencias.

No. El que selecciona es el capitán, previo consentimiento del armador. Hay poca rotación de personal. Los tripulantes son los mismos desde hace tiempo.

Sí. Que no sean problemáticos.

**3. ¿Cuáles áreas de pesca son las que presentan mayores problemas ambientales?**

Parte externa del golfo y Manta. Desembocaduras de los ríos. Todo el golfo, lleno de basura. Los fondos marinos cerca de la costa Tárcoles. La zona sur con mucho palo. Hacia el sur, especialmente en las desembocaduras de los ríos. Las zonas de camarón blanco hacia el Sur y en Manta. Todo el golfo.

**4. ¿La forma en que se realiza la actividad pesquera ha cambiado con el tiempo? ¿Cómo ha sido ese cambio?**

Sí. La producción ha disminuido, antes los viajes de pesca eran más cortos arrastraban menos tiempo, más rentables.

Hace 30 años, se usaban redes más pequeñas. El mar estaba más limpio. Ahora existe competencia internacional y los costos son un factor crítico.

La tecnología y los sistemas de refrigeración han cambiado. Algunos mencionaron cambios en la legislación, el TED or, tal vez, la conversión de barcos a palangreros.

Pero, una mitad observeron que, en general, desde hace 30-50 años los cambios han sido lentos. pueden haber ocurrido leves cambios tecnológicos, por ejemplo la cantidad de FACA puede disminuir con ajustes en los tablones.

**5. ¿La percepción de los daños ambientales ha cambiado con el paso del tiempo?**

Las respuestas fueron diferentes:

En general, hay noción de los daños y se ha ido adquiriendo noción sobre la importancia de las vedas.

Las empresas ubicadas en la costa producen mucho desecho tóxico, consideran que la basura no afecta, pero más por ignorancia que por otra cosa.

Hay más basura y las basuras han incrementado. En particular, los troncos y palos, sobretodo en el Sur, donde han incrementado con el tiempo.

Alguno piensó que no hay daños causados por el barco.

Todos provocan daño, hay que minimizar el daño para que la actividad sea sostenible.

El camaronero ayuda a remover basuras que han incrementado del Trido.

Se necesita un poco más de conciencia, en última instancia la culpa es del Estado porque las leyes han sido acomodadas a los intereses de ciertos grupos.

La gente ahora conoce los daños sobre las especies, porque se evidencian en las capturas y se compara con el auge de antaño.

El fenómeno del Niño, en el corto plazo con el último evento todavía no se han estabilizado.

**6. ¿Qué opina del excluidor de tortugas (TED)?**

Desde que se implantó su uso, se ha tratado de respetar. Su función es buena pero permite que se pierda y se atasque el camarón.

En consideración de la regulacion actuale sobre el TED, alguno pienso que la reja del TED no funciona a 4 pulgadas entre las barras y , deberían abrirse. Sin embargo, INCOPESCA está muy manipulado por pescadores y comerciantes.

Existe un exceso de basura de todo tipo, mucha de ésta se acumula en el TED y el TED se atasca. Al fin, TED no funciona adecuadamente.

Está diseñado para proteger a la especie. Los empresarios tratan de cumplir, pero cuando el que incumple es el capitán la empresa es la que sufre. No hay forma de sancionar al capitán, dado que no existe una adecuada escuela de marina en el país.

No sirve para nada, igual llegan las tortugas pegadas y cuando un palo se atasca en el TED, no sale nada. Al Norte no hay tanto problema en el funcionamiento del TED, porque hay menos basura.

Este aditivo a destruido el negocio!Es una imposición, una barrera arancelaria!

Deberían tratarse otras alternativas como por ejemplo las vedas por zonas - para proteger zonas de desove - o elaborar un plan de manejo.

Innecesario, porque las capturas son erráticas, la captura de una u otra tortuga no justifica el uso del TED.

Es nefasto, ha ocasionado una reducción en la captura del camarón. Además, aspectos técnicos, relacionados con el ambiente marino de Costa Rica, han provocado problemas en su uso. Los linieros tal vez matan más tortugas y no se fijan en ellos.

**7. ¿En cuánto económicamente afecta el TED a la empresa?**

Es difícil decir un porcentaje, pero es bastante, más de 30%, en el orden del 40 al 50 %.
Además, hay que trabajar más para lograr la misma captura.

**8. Con el pasar de los años antes de que se usara el TED, como percibió usted la cantidad de tortugas que eran atrapadas en la red ¿aumentaba o disminuía el número?**

Hai no respuestas

**9. ¿Se le han introducido cambios tecnológicos a las embarcaciones en los últimos diez años?**

La mayoría coincidió en el GPS, la ecosonda y los teléfonos celulares. También mencionaron la introducción de barcos refrigerados.

**10. ¿La FACA es un problema? ¿Qué se podría hacer con la FACA? Si tiene una idea de uso productivo ¿Cómo se podría llevar a la realidad?**

El problema radica en que la FACA se bota y se vuelve a capturar. Esto ocasiona un daño irreversible. Pero la mayoría concidieron que la FACA no es un problema.

Se comercializa aproximadamente un 10% de la FACA.

La FACA es un beneficio, de los ingresos netos el 40% se lo reparte la tripulación.

No. El pescado va para la empresa, el resto es de la tripulación.

No. Es un beneficio para la empresa.

El mercado de mariscos se ha desarrollado mucho.

El problema es que se debería aprovechar mejor. Se puede emplear para la fabricación de embutidos.

Hai un problema de "subutilización", porque no se aprovecha en su totalidad.

**11. ¿La cantidad de barcos que operan sobre el camarón es la adecuada?**

Algunos considieron que está bien la cantidad actual.

Los cambios en la pesca se deben a cambios ambientales

Otros mencionaron:

Dado que los barcos de frigoríficos desaparecieron, podrían reponerse mediante otros barcos.

Si cada uno estuviera en su actividad, sería una cantidad adecuada -tal vez, ligeramente elevada-. Los camaroneros de profundidad a veces pescan en la costa, lo cual provoca sobrepesca.

Hay pocas áreas de pesca, si se aumenta el número de barcos se producirá más miseria. Un barco sólo recoge de 5 a 6 libras de blanco.

Sería injusto que se eliminaran barcos porque también se eliminarían puestos de trabajo, pero que no entren más.

En las condiciones actuales es difícil sobrevivir.

Deberían haber menos embarcaciones; los permisos que se pierden no deberían ser reactivados.

No es conveniente que los barcos de fondo lleguen a la costa.

Debe reducirse el tamaño de la flota porque se están violando las leyes.

El número de embarcaciones actuales es excesivo, la flota debería reducirse o por lo menos mantenerse, los barcos de profundidad no deberían usarse en la costa.

Debe considerarse el informe de la FAO del año 92; debe efectuarse una reducción del 30%, sólo los barcos frigoríficos han sido eliminados.

## 4. Discusión

Las respuestas obtenidas para el caso de los capitanes, reflejan datos semejantes en todo lo relacionado con la operación del barco y sus rendimientos. En general, se obtuvieron respuestas similares ante preguntas tales como: ¿Cuántos días promedio por mes sale el barco? ¿Qué cambios tecnológicos se han introducido en las embarcaciones?.

Hay una fuerte percepción sobre la cantidad de troncos presentes en las aguas, que entorpecen la faena pesquera. No hay comentarios sobre el daño que produce el barco, sin embargo, en una pregunta posterior mencionan que existe, al menos por parte de los capitanes, conciencia sobre el impacto ambiental que ellos ocasionan.

La actividad pesquera camaronera arrastrera es para los capitanes poco dinámica, no cambia con el paso de los años.

En cuanto a los problemas sociales, los capitanes fueron relativamente herméticos. Hacen una ligera mención sobre los problemas de alcoholismo, promiscuidad, desintegración familiar, y algunos casos de drogadicción. La solución al problema es tratada de diversas formas, pero ninguno mencionó el tema de la educación. Según las encuestas, la solución básicamente consiste en elevar los salarios o buscar otro tipo de trabajo.

Al preguntar sobre el TED, se obtienen las respuestas tradicionales de poco funcional y que debería usarse en unas zonas más que en otras. Adicionalmente, concuerdan en que el daño económico ronda entre el 50% y el 60 %. Las respuestas sobre la cantidad de tortugas muertas, halladas después de introducirse el TED, son muy variables.

Al preguntar sobre la FACA, la mayoría concuerda en que es un beneficio. Sin embargo, no fue posible determinar la cantidad que se devuelve al mar.

Según los capitanes entrevistados, el tamaño de la flota está bien o ligeramente sobredimensionado.

En el caso de los tripulantes, las respuestas reflejan datos similares en todo lo relacionado con la operación del barco, rendimientos y cambio tecnológico. Muy semejante a los capitanes.

De nuevo el problema ambiental más grave son los troncos y palos al Sur. Esta situación se agrava en las desembocaduras de los ríos tales como el Térraba y Tárcoles.

Los tripulantes tienen una percepción similar a la de los capitanes, en cuanto a lo poco dinámico de la actividad.

En cuanto a los problemas sociales, los tripulantes fueron, en general, menos abiertos que los capitanes. Sus respuestas hacen referencia a los problemas tradicionales, pero no hacen referencia al problema de la educación. Un problema adicional fue el bajo salario, sólo uno de los entrevistados mencionó estar tranquilo con el trato que le daba la empresa. Para ellos la situación se solucionaría con mejores salarios.

Las respuestas sobre el TED fueron disímiles, la mayoría coincidió en afirmar que era injusto. El impacto económico para ellos iba desde un 40% hasta un 70 %. Según ellos pocas tortugas mueren atrapadas en la red.

Las respuestas sobre el tamaño de la flota fueron disímiles.

Para el caso de los armadores, las respuestas tuvieron en general una mayor variabilidad. Ellos sopesan muchos parámetros al momento de responder preguntas tales como la duración promedio por viaje, las salidas promedio por mes. Sin embargo, sus respuestas coincidieron en lo relativo a los cambios de tecnología electrónica.

Una buena parte de los armadores prefiere que sus capitanes escojan la tripulación. En el caso de tres empresas, las respuestas reflejaron una rotación relativamente baja de tripulantes. Una respuesta

diferente, estuvo relacionada con la profesionalización de las tripulaciones, en el sentido de que el país no exigía flotas profesionales y ante tal circunstancia era difícil hablar de selección.

La percepción del daño ambiental es más amplia en los armadores. Para ellos es importante tomar en cuenta además de los troncos y palos, la basura que es arrastrada por los ríos. Además, todos sienten que el impacto de la basura y los palos ha aumentado en el tiempo.

La mayoría de los entrevistados no ha percibido cambios en la forma como se realiza la actividad pesquera, al parecer los cambios son muy lentos.

Las respuestas de los armadores fueron, en general, muy duras en relación el comportamiento de las tripulaciones. En este aspecto las respuestas varían mucho de las respuestas de los tripulantes y los capitanes. Los temas de la promiscuidad, el alcoholismo, las drogas, la desintegración familiar y la baja escolaridad, parecen ser los problemas primordiales. La solución que dan se perfila en torno a la educación, ya sea para los hijos o para los mismos tripulantes.

Para todos los armadores, el TED es un gran problema. La percepción del impacto económico es, en general, menor que la reportada por capitanes o tripulantes, y va desde un 25% hasta un 50%. La percepción sobre las tortugas atrapadas es variable, pero hay una tendencia a mencionar que es similar.

El mantenimiento parece ser el factor que asegura la eficiencia de las embarcaciones, sobre todo, si se toma en cuenta la dificultad que existe para obtener créditos y poder cambiar los barcos.

En general, los barcos seleccionados son relativamente viejos. La mayoría son de 20 o más años de antigüedad. La renovación de la flota se ve más en función de reparaciones, pues la compra de nuevos barcos ha sido muy baja.

La FACA no es un problema. Por el contrario, es considerada como una posibilidad de nuevos ingresos que contribuyen a mitigar, en parte, el impacto sufrido por la disminución en la pesca de camarón.

Las repuestas en torno al tamaño de la flota están divididas entre mantener la flota o disminuirla. Sólo uno de los entrevistados menciona que deberían, al menos, reponerse los barcos. Se comenta por varios armadores la presencia de arrastreros de profundidad en zonas no autorizadas, lo cual afecta las capturas de los otros barcos camaroneros. Durante las entrevistas también se dejó entrever la pugna silenciosa que existe por parte de los arrastreros de profundidad para que el INCOPESCA les permita acceder al recurso camarón en la costa.

## 5. Conclusiones

El quehacer de la empresa camaronera arrastrera, está muy relacionado con el tamaño de ésta. A pesar de ser pocos barcos, en el subsector se generan microempresas, para el caso de un empresario y su barco; pequeñas empresas, para el caso de armadores con dos barcos o más; y se pueden encontrar también empresas medianas, en menor número. Lo anterior dificulta aún más la toma de decisiones, porque los microempresarios están más expuestos ante cambios económicos, legales o políticos.

La flota camaronera afronta una crisis. Unido al problema biológico, con la tasa de repoblamiento del camarón, se presentan otros problemas relativos al manejo de los costos de operación. De nuevo, los microempresarios son los más sensibles. Las medianas empresas resultan en este caso menos afectadas debido a la economía de escala.

El recurso humano tiene graves problemas sociales, debido al bajo nivel de escolaridad. Además, la percepción de los armadores hacia las tripulaciones, en términos generales, es negativa. Esto profundiza los problemas, sin embargo, existen algunas empresas que han logrado mantener una baja rotación de personal mediante diversas estrategias, las cuales, en muchos casos, son implícitas. Esto les permite tener rendimientos aparentemente mejores, con respecto a otras empresas dentro del mismo subsector.

Aunque la actividad camaronera tiene más de 40 años, el nivel de profesionalismo es muy bajo. No existen estándares oficiales que permitan coadyuvar a mediano plazo con un mejoramiento de la situación social del recurso humano. La solución no radica sólo en mejores salarios, sino también en

promover cambios en la cultura de los tripulantes y de los mismos armadores. Este bajo profesionalismo disminuye la capacidad del sector para ser más perceptivo ante los cambios.

La percepción de pocos cambios, dentro de la actividad a lo largo del tiempo, parece haber influido en la actitud que el subsector tiene con respecto al uso de nuevas tecnologías. Esto se agrava en el caso de aquellas tecnologías que internalizan los coros ambientales provocados por la actividad camaronera, como en el caso del uso del TED. A pesar de los seminarios y de la capacitación, los empresarios y sus tripulaciones muestran una reacción muy negativa hacia el uso de dicho aditamento. Aparentemente, la rígida posición asumida por el gobierno, debido a lineamientos provenientes de otros países, no ha permitido una discusión más abierta en tomo al uso del TED, por ejemplo, existe una solicitud para abrir más las barras o no exigir su uso en ciertas zonas. La comunicación entre los interlocutores no es la más adecuada.

La debilidad expresa del gobierno, para con la gobernabilidad de los mares nacionales, es el ejemplo más claro para concluir que la falta de aceptación del sector, podría estar provocando que las tripulaciones indiquen que efectivamente están usando los TED, pero la realidad en el mar puede ser una cosa totalmente diferente. El gobierno debería tratar de lograr un mayor diálogo, con el propósito de que el convencimiento mutuo sea el que lleve a cuidar adecuadamente la población de tortugas que llega a la costa.

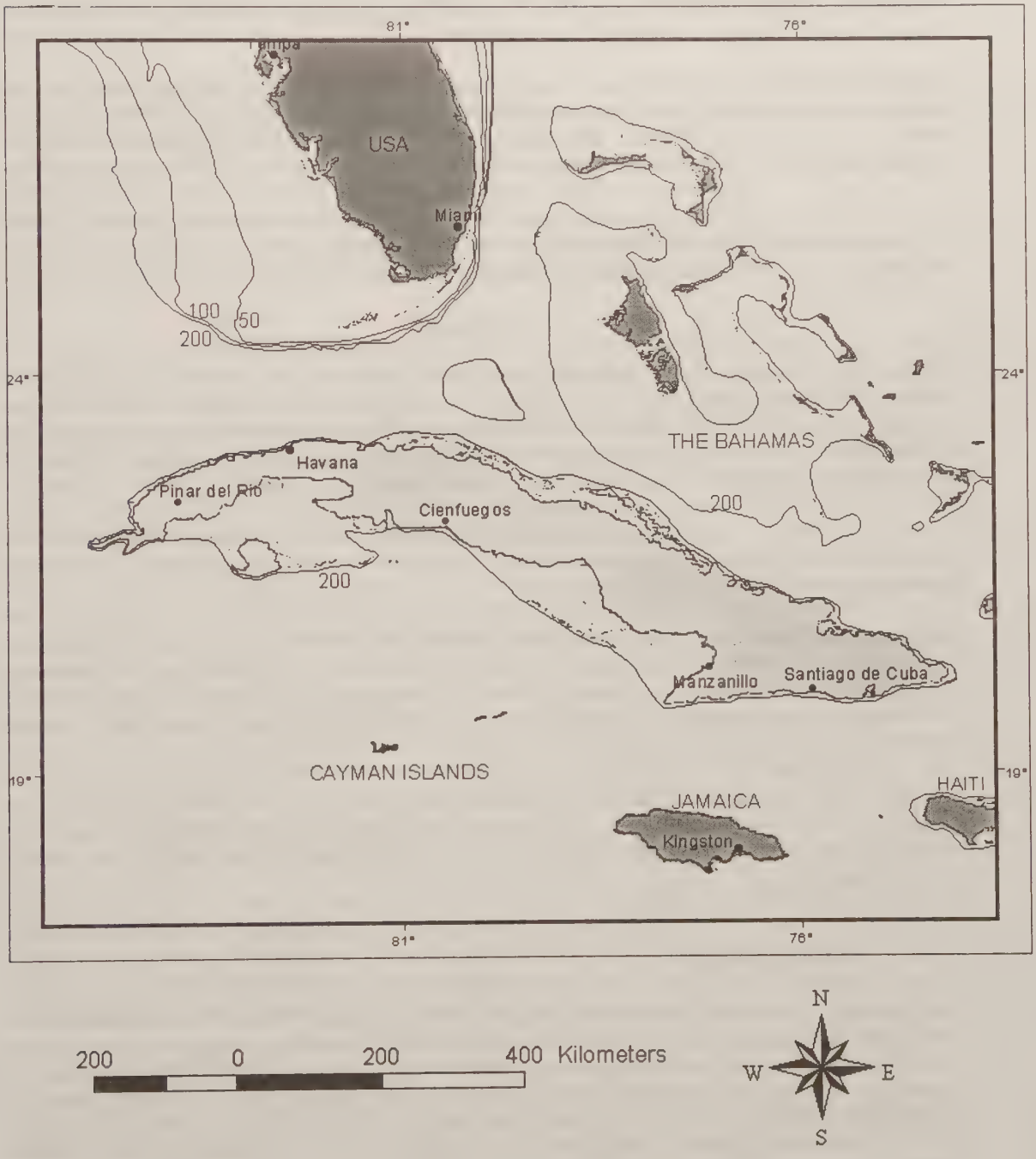
La FACA es una solución más que un problema, la crisis misma del sector ha hecho que para muchas empresas la FACA sea un ingreso importante que compense las disminuciones en las capturas. Sigue latente el problema de la FACA que es descartada, uno de los armadores ha manifestado que existen en otros países técnicos y tecnologías que permiten en los arrastres disminuir la FACA.

La percepción del sector sobre el tamaño de la flota no es unánime, pero la mayoría plantea el mantener la flota en los niveles actuales.

**CUBA**

**REPORTE NACIONAL SOBRE EL IMPACTO DE LA FAUNA INCIDENTAL EN LA PESCA DE ARRASTRE DEL CAMARON**

Por Lic. Luis Font Chávez; Coordinador Nacional (Misterio de la Industria; Centro de Investigaciones Pesqueras; 5ta Ave. y 248, Barlovento Playa, Ciudad de La Havana; **Cuba;** Fax: 53 7 24-9827
E-mail: cubacip@ceniai.inf.cu )



Abstract

The shrimp catches of the trawl fishery were almost 2 000 t in 1997 in addition an average of 11 000 t of fish was landed.

The ratio of shrimp to other catch is 1:6-8. Approximately one fifth of the non-shrimp catch is landed for human consumption, fresh or processed and the rest is reduced to fish meal or silage for animal consumption.

In 1999, the shrimp trawling fleet consisted of 51 units, fishing mainly at night, and assisted by support vessels for daily transfer of shrimp and incidental catch to port.

Different regulations are applied, related to the increase of mesh size in trawl nets, significant reduction of fishing effort, total or partial closure during recruitment seasons, no fishing at less than 1 nautical mile from the coast and in known high density juvenile areas as well as in areas characterized by predominant small size individuals (more than 20-25%).

The exploitation of the shrimp resources appears to be under control: the level of exploitation at present is at a sustainable level; the fleet involved is properly, carefully monitored and detailed statistics regarding catch and by-catch have been maintained for years.

Resumen

Las capturas de camarón, producto de la pesca de arrastre, alcanzaron las 2.000 toneladas métricas en 1997, sumado a las 11.000 toneladas de pescado descargadas en promedio ese año.
La relación entre las capturas de camarón y otras capturas es de 1:6-8. Aproximadamente un quinto de las capturas no camaroneras se descargan para consumo humano, fresco o procesado, y el resto se emplea en la producción de harina de pescado o ensilado para consumo animal.

En 1999, la flota de arrastre de camarón estaba constituida por 51 unidades dedicadas a la pesca nocturna, asistidas por embarcaciones de apoyo en la transferencia diaria del camarón y la fauna de acompañamiento (pesca incidental) al puerto.

Se aplican diferentes regulaciones relativas al incremento de abertura de malla de las redes de arrastre, a la reducción significativa del esfuerzo de pesca, al cierre total o parcial durante la estación de reclutamiento, a la prohibición de pesca a menos de 1 milla náutica de la costa y en áreas donde se conoce existe una alta densidad de juveniles, así como también en áreas caracterizadas por predominio de individuos de talla pequeña (más del 20-25%).

La explotación del recurso camaronero parece estar bajo control: el nivel de explotación actual se encuentra en un nivel sostenible; la flota involucrada se vigila en forma apropiada y cuidadosa y también se han mantenido por años estadísticas detalladas con relación a las capturas y la fauna de acompañamiento.

## 1. INTRODUCCIÓN

Las pesquerías de arrastre camaronero en la región, producen un gran volumen de organismos marinos como captura incidental, determinada por las características de la tecnología pesquera utilizada, con un bajo nivel de selectividad para las especies que cohabitan junto con la especie objeto de la explotación comercial. Se produce el incremento de la mortalidad de otras especies, que por diversos factores de tipo económico, político, social y otros, hacen que una parte considerable de las mismas sea devuelta al mar, provocando diferentes efectos en las poblaciones y el medio ambiente marino. Diversos esfuerzos han sido realizados por varios países y organizaciones internacionales, con el objetivo de disminuir las capturas no deseadas y por otra parte, lograr el aprovechamiento industrial de las mismas, como fuente alternativa para la alimentación humana o animal, teniendo en cuenta su valor proteico y las limitaciones de carácter económico, específicas de cada país, para cubrir sus necesidades alimentarias.

Para emprender acciones tendentes a minimizar el impacto sobre las especies, que componen la captura incidental y su hábitat, fue iniciado en marzo de 1999 el proyecto "Reducción del impacto de las pesquerías tropicales de arrastre camaronero sobre los recursos marinos vivos, a través de la adopción de técnicas y prácticas protectoras del medio ambiente", auspiciado por GEF (Global Enviroment Facility), UNEP (United Nations Environment Programme) y FAO (Food and Agriculture Organization), cuyos objetivos están dirigidos a la promoción de mejores prácticas y tecnologías pesqueras, incluyendo el uso de los BDRs y la eliminación de las barreras existentes para la implementación de las mismas.

En nuestro caso, el camarón constituye el segundo recurso exportable de la industria pesquera cubana, aportando en la actualidad cerca de 15 millones de dólares anuales y la cual se desarrolla fundamentalmente en la zona suroriental del país, que aporta el 99% de las capturas totales.

A partir de la década de los 80, con el descenso en las capturas y teniendo en cuenta los resultados de las investigaciones, se establece un sistema de medidas de regulaciones pesqueras, el cual ha sido necesario perfeccionar acorde al comportamiento del recurso camaronero, así como de su fauna acompañante, teniendo en cuenta la existencia de otros factores de origen antrópico (represamiento) y naturales (sequía) que afectan las poblaciones presentes en el área de exploitación.

Como resultado de estudios más recientes, se han propuesto nuevas recomendaciones para el manejo de los recursos, que incluyen un desplazamiento del período de veda y la modificación de la estrategia pesquera.

En relación con la captura incidental de esta pesquería, en la década de los 60 se comenzaron estudios cuantitativos y cualitativos de la misma que permitieron, junto con el establecimiento de un sistema de selección mantenimiento y traslado a puerto, el desembarque de casi la totalidad de las capturas para su procesamiento industrial a partir de 1989. La existencia de tecnologías, acorde con las características de las especies que la componen, ha permitido la elaboración de productos con buenas características organolépticas y su aceptación en el mercado nacional e internacional, así como el procesamiento de la fracción no utilizable para la alimentación animal. La comercialización de estos productos, alcanza en la actualidad un monto de 5.6 millones de pesos anuales.

En el marco de los objetivos del proyecto, el presente documento aborda, además, los aspectos referidos a la administración y organización de las pesquerías, la tecnología pesquera utilizada, el procesamiento industrial, la comercialización de las producciones, así como los resultados acerca del impacto sobre los recursos marinos, derivados por las técnicas y prácticas actualmente en uso.

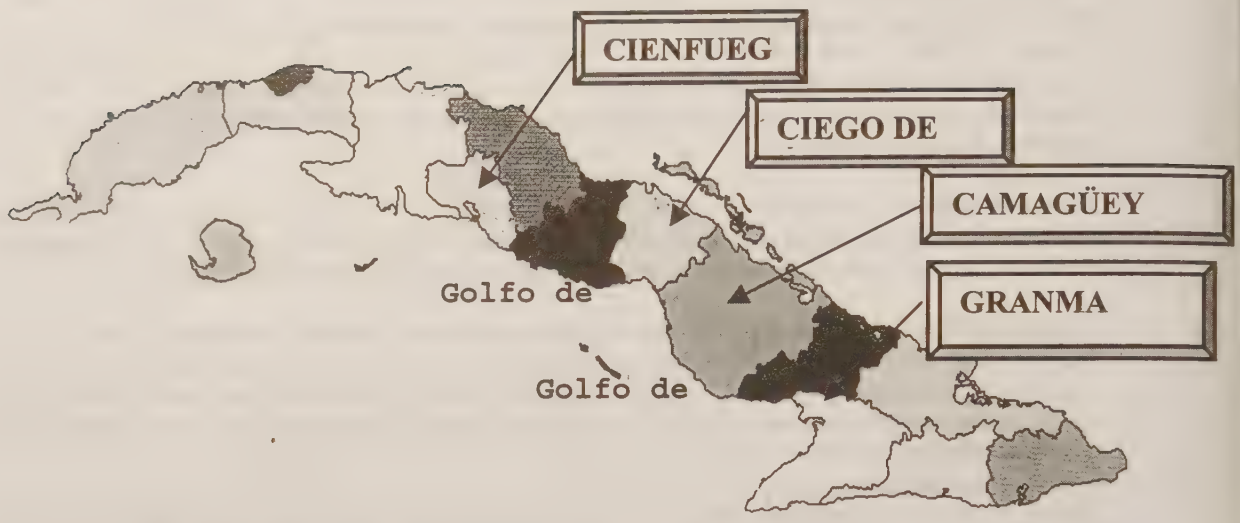
Finalmente se plantean un cuerpo de recomendaciones, relativas a las acciones a desarrollar, tanto en el ámbito nacional, regional como global, las cuales consideramos que tendrán un efecto importante, en el cumplimiento de los objetivos de este proyecto, con miras a la adopción de técnicas y prácticas, que protejan el medio ambiente.

## 2. LA PESQUERÍA DE CAMARÓN

El camarón se encuentra asociado a zonas donde existen aportes fluviales con sedimentos, fundamentales para su alimentación y reproducción, por esto en Cuba la pesquería de arrastre camaronero se desarrolla básicamente en la región suroriental de la plataforma cubana, en la que se destacan los golfos de Ana María y Guacanayabo, donde el arribo de partículas organógenas y minerales en suspensión acarreada por los ríos, provoca acumulación de fango.

### 2.1 Especies presentes

Existen dos especies de camarones comerciales, la principal y de más amplia distribución es el rosado o acaramelado (*Penaeus notialis*, Pérez-Farfante, 1967) que constituye en la actualidad más del 98% de las capturas nacionales, y el camarón blanco (*Penaeus schmitti*, Burkenroad, 1936).




**Principal área de pesca del camarón en la región suroriental.**

## 2.2 Características del área de distribución

| | |
|---|---|
| Características de los fondos | Arcilloso con bancos rocosos y sedimentos areno-fangosos |
| Superficie | 18 702 km² |
| Área arrastrable | Aproximadamente: 6 200 km² |
| Profundidad media | 15 metros |
| Profundidad máxima | 30 metros |

## 2.3 Estado actual del recurso camaronero

Explotado al nivel máximo, con problemas determinados por factores climáticos y represamiento de los ríos.

## 2.4 Características de la flota camaronera

No existe pesquería artesanal, toda la pesca es industrial.

Cantidad de barcos por empresas camaroneras y por actividades

| ASOCIACIÓN | EMPRESA | B. FUNCIÓN QUE REALIZA EL BARCO | | | | |
|---|---|---|---|---|---|---|
| | | PESCA | ENVIADA* | TALLER | PONTÓN | ENVIADA** |
| C. CIENFUEGOS | | 11 | 3 | 1 | 2 | 1 |
| CIEGO DE ÁVILA | | 5 | 1 | | | |
| CAMAGÜEY | PLAYA FLORIDA | 7 | 1 | 1 | | |
| | STA. CRUZ del S | 12 | 2 | | | 1 |
| GRANMA | | 13 | 2 | 1 | | 1 |
| TOTAL | | 48 | 9 | 2 | 2 | 3 |

* Para camarón y la fauna acompañante.
** Para la morralla.

Características del casco

| Material del casco | Cantidad | Edad promedio | Eslora (m) |
|---|---|---|---|
| Plástico | 2 | 3 | 23 |
| Ferrocemento | 10 | 9 barcos con 5-8 años<br>1 con más de 9 años | 21 |
| Ferrocemento | 34 | 13 barcos con 0-4 años<br>20 barcos con 5-8 años<br>1 con más de 13 años | 18 |
| Acero (Caribe) | 17 | 2 barcos con 0-4 años<br>15 barcos con 5 –8 años | 23 |
| Acero (Peruano) | 1 | Más de 20 años | 20.3 |

Características de los motores

| Motor principal* | Cantidad | Potencia (HP) |
|---|---|---|
| D.Yanmar | 3 | 400-470 |
| Volvo Penta | 9 | 420 |
| Volvo Penta | 50 | 300-350 |
| Otros | 2 | |

* Todas las embarcaciones dedicadas al arrastre tienen, además, un motor auxiliar con una potencia entre 3.6 y 5 caballos de fuerza.

### 2.5 Artes de pesca

En la actualidad todos los barcos camaroneros emplean redes gemelas de cuatro placas del tipo Flat Shrimp Trawl. Estas redes son construidas con mallas de multifilamento de nailon (PA-6), de alta tenacidad, hilo torcido (3 cabos, torsión z), con termofijación y tratamiento antisolar, color negro, de 210d/36-26 milímetros de paso de malla en el cuerpo y 210d/72-20 milímetros de paso de malla en el copo. Las redes pueden llevar indistintamente en la puerta neutral un **patín** o **trineo** (dummy door) o un peso llamado **monito** (bullet); las **patas de gallina** (bridle) son de cable de acero de 11 milímetros de diámetro y 46 metros de largo y cable de arrastre de acero de 13 milímetros de diámetro. Las puertas de arrastre son construidas de madera con una dimensión de 0,76 x 1,7 metros y se regulan para un ángulo de ataque de 30-32. La relinga superior no tiene flotadores, y la inferior se apareja con **aretes** - pedazos de cadenas de 7 eslabones, con 12.7 milímetros de diámetro y 1 kilogramo de peso - que garantizan un mayor asentamiento de la relinga inferior. Existen dos diseños de redes (10.4/10.4 y 9.9/9.5).

Principales índices de las redes de arrastre 10.4/10.4 m (B-IV-11B) y la tradicional

| ÍNDICE | UNIDAD | RED 10.4/10.4 m | RED 9.9/9.5 m |
|---|---|---|---|
| Abertura vertical de la red | m | 1 | 1 |
| Abertura horizontal de la red | m | 8 | 7 |
| Área de la boca | $m^2$ | 6.3 | 5.5 |
| Lastre unitario | Kgf/m | 0.8 | 0.83 |
| Rendimiento de filtración | $m^3$/hora | 3.5.10 | 3.0.10 |
| Área ficticia de los paños total | $m^2$ | 165.3 | 156.0 |
| Zona de acción de arrastre (4 redes) | $m^3$ | 51.0 | 48.0 |

## 2.6 Esfuerzo pesquero

Esfuerzo Pesquero (Días Pesca) período 1983-1998

| AÑO | Días pesca | AÑO | Días Pesca |
|---|---|---|---|
| **1983** | 32365 | **1992** | 15897 |
| **1984** | 29685 | **1993** | 14050 |
| **1985** | 25701 | **1994** | 14627 |
| **1986** | 24542 | **1995** | 14624 |
| **1987** | 23186 | **1996** | 13960 |
| **1988** | 21261 | **1997** | 11336 |
| **1989** | 21185 | **1998** | 8548 |
| **1990** | 15896 | **Promedio** | 18849 |
| **1991** | 14728 | | |

## 2.7 Prácticas de pesca

Actualmente los barcos son mantenidos en la zona de pesca y se rotan las tripulaciones por medio de las propias enviadas de cada asociación, e incluso, los barcos talleres realizan todas las reparaciones que sean factibles en la propia zona. No obstante, cada barco trabaja como promedio 20 días en el mes y pesca alrededor de 12 horas cada día, realizando 4 lances de 3 horas de duración.

Se trabaja fundamentalmente en horario nocturno (de las 18:00 hasta las 06:00). La velocidad de arrastre puede variar (según las características del motor, barco, zona de pesca, entre otros) entre 2.8 y 3.2 nudos, pero se considera que la óptima es de 3 nudos.

Una vez que la captura está en la cubierta del barco se procede a su selección, separando los camarones de talla comercial de la trilla[3/] y de la fauna acompañante. Para su conservación, lo camarones se guardan en recipientes con agua helada y las especies de la fauna acompañante destinadas al consumo humano, en cajas con hielo molido. La morralla[4/] es mantenida en cubierta.

Diariamente por la mañana, cada barco entrega las capturas obtenidas durante la noche a las enviadas, que son las encargadas de trasladarlas al puerto correspondiente para ser procesadas en la industria.

## 2.8 Comportamiento de las capturas

Captura en toneladas métricas (TM) período 1983-1998

| AÑO | TM | AÑO | TM |
|---|---|---|---|
| **1983** | 4.349,1 | **1992** | 2.593,0 |
| **1984** | 4.228,1 | **1993** | 2.719,4 |
| **1985** | 4.810,3 | **1994** | 2.227,7 |
| **1986** | 4.541,2 | **1995** | 1.841,0 |
| **1987** | 4.532,9 | **1996** | 1.663,9 |
| **1988** | 4.439,5 | **1997** | 1.990,8 |
| **1989** | 3.280,5 | **1998** | 1.236,3 |
| **1990** | 2.380,0 | **Promedio** | 3.101,7 |
| **1991** | 2.793,0 | | |

[3] trilla: se refiere a los camarones que por su tamaño pequeño, estado de muda o daños mecánicos tiene menos valor comercial y conforman un grupo independiente.

[4] morralla: se refiere a las especies que componen la captura incidental y no son destinadas al consumo humano.

## 2.9 Fauna de acompañamiento y su aprovechamiento

Especies presentes en la captura incidental

Hasta el presente, han sido identificadas más de 130 especies, de las cuales 87 especies, 66 géneros y 46 familias pertenecen al grupo de los peces; 16 especies, 12 géneros y 9 familias de crustáceos; 14 especies, 11 géneros y 10 familias de moluscos; 3 especies, 3 géneros y 3 familias de esponjas, así como 2 especies, 2 géneros y 1 familia de holoturias.

## 2.10 Desembarques de captura incidental

| AÑO | MORRALLA | | MOLUSCOS | | CRUSTÁCEOS | | PECES | | CONSUMO HUM. | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TM | % | TM | % | TM | % | TM | % | TM | % | TM |
| 1984 | 19.985,8 | **90,4** | 86,2 | 4,1 | 604,7 | 24,6 | 1.431,2 | 67,4 | 2.122,2 | **9,6** | 22.108,0 |
| 1985 | 21.539,7 | **89,8** | 95,5 | 3,9 | 666,2 | 26,2 | 1.696,5 | 69,0 | 2.458,3 | **10,2** | 23.998,0 |
| 1986 | 22.181,5 | **89,7** | 37,8 | 1,5 | 851,8 | 28,8 | 1.648,9 | 65,0 | 2.538,5 | **10,3** | 24.720,0 |
| 1987 | 21.253,4 | **87,8** | 50,0 | 1,7 | 777,5 | 24,3 | 2.130,0 | 72,0 | 2.957,5 | **12,2** | 24.210,9 |
| 1988 | 21.665,4 | **87,1** | 33,4 | 1,0 | 1.009,9 | 35,0 | 2.162,8 | 67,5 | 3.206,1 | **12,9** | 24.871,5 |
| 1989 | 22.298,4 | **88,5** | 26,1 | 0,9 | 845,6 | 37,9 | 2.014,6 | 69,8 | 2.886,4 | **11,5** | 25.184,8 |
| 1990 | 15.463,7 | **87,4** | 14,0 | 0,6 | 540,4 | 19,8 | 1.674,3 | 75,1 | 2.228,7 | **12,6** | 17.692,4 |
| 1991 | 13.833,7 | **83,5** | 18,8 | 0,7 | 544,9 | 19,7 | 2.168,3 | 79,4 | 2.731,9 | **16,5** | 16.565,6 |
| 1992 | 14.183,0 | **83,7** | 12,5 | 0,5 | 586,9 | 33,2 | 2.170,9 | 78,4 | 2.770,3 | **16,3** | 16.953,3 |
| 1993 | 9.830,4 | **84,8** | 8,3 | 0,5 | 378,2 | 13,8 | 1.381,4 | 78,1 | 1.767,9 | **15,2** | 11.598,4 |
| 1994 | 12.081,6 | **81,5** | 7,4 | 0,3 | 520,4 | 21,5 | 2.221,9 | 80,8 | 2.749,8 | **18,5** | 14.831,4 |
| 1995 | 9.783,2 | **80,2** | 7,4 | 0,3 | 325,4 | 15,6 | 2.085,1 | 86,2 | 2.417,9 | **19,8** | 12.201,1 |
| 1996 | 6.655,3 | **76,1** | 11,5 | 0,6 | 426,2 | 23,1 | 1.648,4 | 79,0 | 2.086,2 | **23,9** | 8.741,5 |
| 1997 | 10.086,9 | **84,5** | 1,6 | 0,1 | 403,5 | 47,0 | 1.441,8 | 78,1 | 1.847,0 | **15,5** | 11.933,9 |
| 1998 | 7.747,5 | **90,0** | 0,3 | 0,0 | 167,1 | 6,8 | 691,8 | 80,5 | 859,2 | **10,0** | 8.606,7 |
| Prom. | 15.239,3 | **86,0** | 27,4 | 1,1 | 576,6 | 23,3 | 1.866,6 | 75,6 | 2.470,6 | **14,0** | 17.709,9 |

## 2.11 Procesamiento industrial

Existen tres asociaciones con infraestructura adecuada para el procesamiento industrial de la FAC. Estas asociaciones están localizadas en la costa suroriental de la isla, en las provincias de Cienfuegos, Camagüey y Granma. Por ser zonas de puerto, no se requiere de transporte terrestre para el traslado de la captura.

## 2.12 Comercialización

### 2.12.1 Camarón

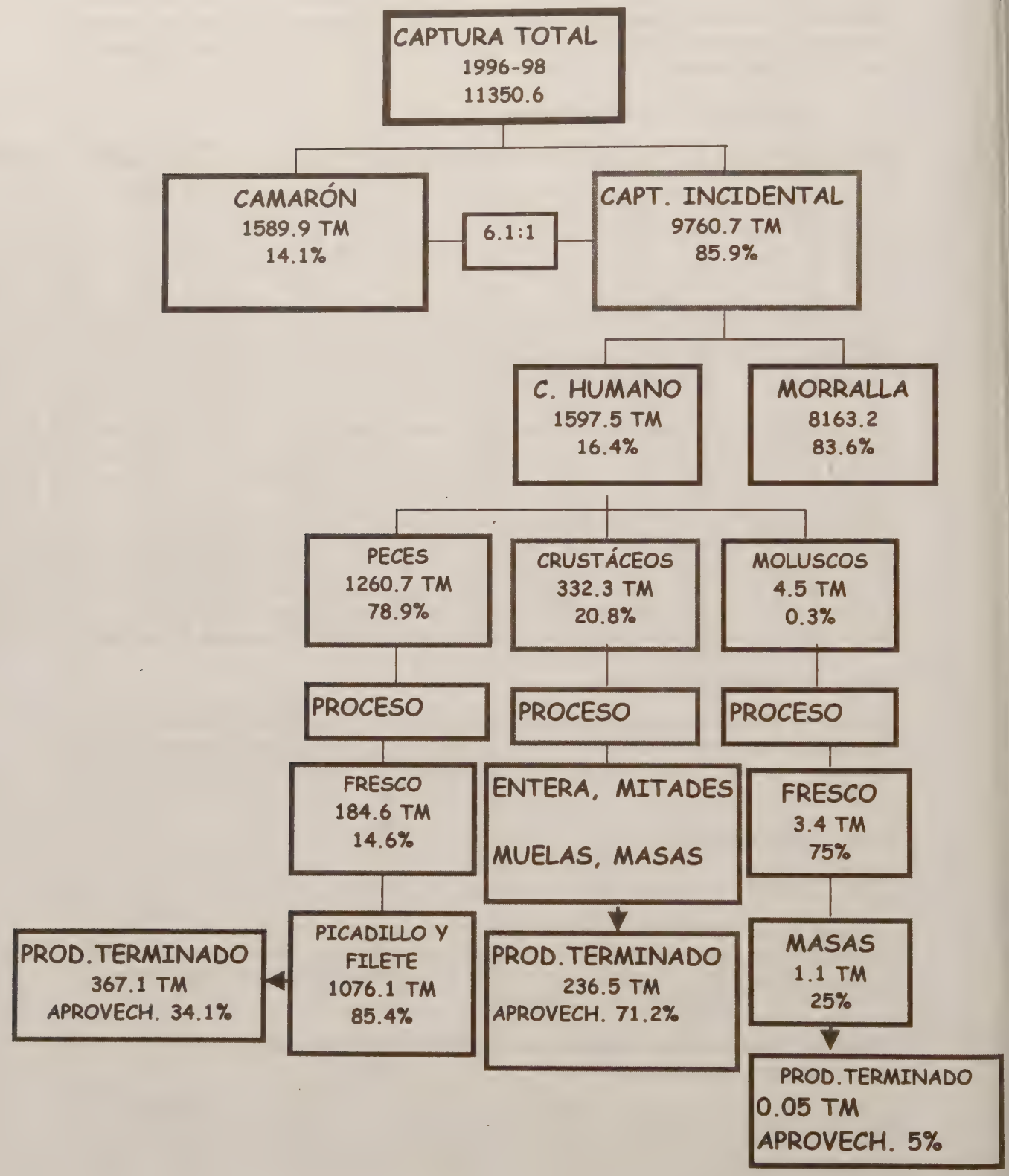
Anualmente, más del 96% de la captura de camarón se destina a la exportación (Tabla 10). Este valor incluye, tanto las exportaciones, como la parte que se comercializa en moneda libremente convertible dentro del país, con destino al sector turístico. Existe también un mercado interno, donde un porcentaje de la producción se comercializa para la población.

**Toneladas destinadas a la exportación y al mercado interno, y porcentaje que representan de la captura nacional. Período 1996-1998**

| | 1996 | 1997 | 1998 | Promedio |
|---|---|---|---|---|
| **MERCADO EXPORTACIÓN*** | 1.614,9 | 1.951,9 | 1.115,6 | 1.560,8 |
| **PORCENTAJE (%)** | 97,9 | 99,6 | 96,2 | 98,1 |
| **MERCADO INTERNO** | 35,2 | 8,7 | 43,5 | 29,1 |
| **PORCENTAJE (%)** | 2,1 | 0,4 | 3,8 | 1,9 |

*Incluye mercado externo y mercado interno en divisas.
(Fuente: Dirección de Industrias del MIP).

En la siguiente figura se muestra el esquema por el cual transitan las especies desde su captura incidental hasta su procesamiento industrial. Los valores son los promedios del período 1996-1998.



### 2.12.2 Fauna acompañante

La comercialización de los productos a partir de FAC se realiza en tres sectores: población, empresarial y turismo.

Aprovechamiento Industrial de los peces que componen la FAC

| Año | FAC desembarcada | FAC a proceso | | Producción final | |
|---|---|---|---|---|---|
| | (TM) | (TM) | (%) | (TM) | (%) |
| **1996** | 1.522,6 | 1.386,8 | 91,1 | 442,3 | 31,9 |
| **1997** | 1.338,0 | 1.163,7 | 87,0 | 360,0 | 30,9 |
| **1998** | 691,7 | 677,9 | 98,0 | 299,1 | 44,1 |
| **Promedio** | 1.183,9 | 1.076,1 | 90,9 | 367,1 | 34,1 |

Aprovechamiento Industrial de los crustáceos desembarcados con la FAC

| Año | FAC desembarcada | FAC a proceso | | Producción final | |
|---|---|---|---|---|---|
| | (ton) | (ton) | (%) | (ton) | (%) |
| **1996** | 426,2 | 426,2 | 100,0 | 283,0 | 66,4 |
| **1997** | 403,4 | 403,4 | 100,0 | 360,6 | 89,4 |
| **1998** | 167,1 | 167,1 | 100,0 | 66,0 | 39,5 |
| **Promedio** | 332,2 | 332,2 | 100,0 | 236,5 | 71,2 |

Aprovechamiento Industrial de los moluscos desembarcados con la FAC

| Año | FAC desembarcada | FAC a proceso | | Producción final | |
|---|---|---|---|---|---|
| | (ton) | (ton) | (%) | (ton) | (%) |
| **1996** | 11,5 | 2,0 | 18,7 | 0,10 | 5,0 |
| **1997** | 1,6 | 1,2 | 75,0 | 0,06 | 5,0 |
| **1998** | 0,3 | 0,0 | 0,0 | 0,00 | 0,0 |
| **Promedio** | 4,2 | 1,1 | 25,4 | 0,05 | 5,0 |

## 3. REGULACIONES Y MEDIDAS DE ADMINISTRACIÓN PESQUERA

Las principales reglas para la ordenación pesquera están contenidas en el Decreto-Ley No. 164 " Reglamento de Pesca" aprobado por el Consejo de Estado de la República de Cuba el 26 de Mayo de 1996.

Entre los aspectos más importantes de esta legislación se encuentran:

- El establecimiento de un Sistema de Autorizaciones de Pesca, mediante el cual cada embarcación de pesca debe poseer la correspondiente licencia que se otorga anualmente.

- El control y vigilancia de todas las regulaciones pesqueras, mediante una Oficina Nacional de Inspección Pesquera (ONIP), que cuenta con 200 Inspectores y los medios técnicos para hacer cumplir la legislación vigente.

- Un sistema de multas y sanciones para aquellos que infrinjan las regulaciones establecidas.

- La Comisión Consultiva de Pesca como órgano asesor y de consulta, para el establecimiento de cualquier tipo de regulación y donde están representados los pescadores comerciales, los pescadores deportivos, las empresas estatales, las universidades, el Ministerio de Ciencia, Tecnología y Medio Ambiente, así como otros sectores interesados (Turismo, Minería, Transporte, entre otros).

Las principales alternativas aplicadas para el ordenamiento pesquero de la pesquería de arrastre del camarón son:

**La regulación de la composición por tallas de la captura y manejo de zonas de cría**

Límite máximo de hasta un 20 – 25% de camarón "trilla".
Vedas estacionales durante la época de reclutamiento.
Vedas permanentes de cinturones costeros de 1 a 2 millas náuticas.
Regulación directa del esfuerzo de pesca
Asignación anual a las empresas del número de días pesca que pueden ejercer.
Otras medidas de ordenamiento

Asignación de derechos territoriales a cada una de las empresas pesqueras del país.

## 4. IMPACTO DEL PATRÓN DE EXPLOTACIÓN ACTUAL SOBRE LOS RECURSOS CAMARONEROS

Durante los últimos 16 años las capturas de este recurso han ido disminuyendo, lo que se explica en parte como una consecuencia de las reducciones en el esfuerzo de pesca. Sin embargo, la reducción del esfuerzo y otras medidas de manejo aplicadas en el pasado, no han bastado para la plena recuperación del recurso.

Independientemente de la acción directa que ejerce el hombre sobre el recurso mediante la actividad pesquera, existen otros factores cuyos efectos pueden introducir, directa o indirectamente, variaciones en el ecosistema marino y, por tanto, inciden sobre las especies que lo habitan.

Entre las actividades que mayor repercusión han tenido sobre el camarón, así como seguramente sobre todos los organismos que habitan el área, están: el represamiento de los ríos y las variaciones climáticas (principalmente el régimen de lluvias, provocando largos períodos de sequías) con el consecuente deterioro de los ecosistemas lagunares y de los manglares costeros.

Se estima que producto del represamiento, ha ido disminuyendo la capacidad de carga del ecosistema y que en los últimos años han dejado de llegar a la plataforma, entre 3.000 a 4.000 millones de metros cúbicos de agua dulce, lo que provoca una reducción de los nutrientes y la afectación de los sistemas lagunares y costeros.

Los resultados más recientes indican que, unido a lo anterior, el patrón de explotación del camarón ha ido variando desde el período 1983-1987 hasta el último quinquenio analizado (1993-1997), debido a la reducción paulatina del largo de primera captura ($L_{50\%}$ de retención), producto, entre otros factores, de la selectividad del arte de pesca, todo lo cual se ha reflejado en las capturas de camarón.

Lo anterior indica la necesidad de perfeccionar el patrón de explotación actual, aumentando la talla de primera captura, mediante la introducción de artes más selectivos y disminuyendo el nivel de esfuerzo en las áreas cercanas a la costa, permitiendo con ello el incremento en talla de los ejemplares capturados y un beneficio económico mayor como producto de la pesca.

## 5. IMPACTO SOBRE LOS RECURSOS MARINOS PRODUCIDO POR LA PESQUERÍA DE CAMARÓN

### 5.1 Efecto de la pesquería de arrastre camaronero sobre las poblaciones de peces

Estudios realizados en la bahía de Cienfuegos por González *et al. (1999)*, concluyeron que la ictiofauna de los sitios de pesca de camarón en la bahía, ha sufrido un notable cambio en su composición desde 1988 hasta 1998, señalando que las especies con tallas más grandes y de mayor

valor comercial, han sido sustituidas en dominancia numérica por especies de tamaño pequeño. Asimismo, plantean que la causa del cambio general observado se atribuye, por una parte, a la afectación de las zonas de reproducción y crianza, tanto por una disminución en el escurrimiento de agua dulce, como por una contaminación de origen y naturaleza múltiple. Por otra parte, la sobrepesca accidental de la FAC puede haber contribuido también al cambio observado.

Fenómenos de similar característica son observados en la zona principal de pesca, por ejemplo, en 1985 se desembarcaron 1 188,5 toneladas métricas del clarín, una especie seleccionada para el consumo humano, con un rendimiento de 50,1 kg/dp, mientras que en 1998 sólo se obtienen 33,1 toneladas métricas con 4,2 kg/dp; por otra parte, la biajaiba mantuvo un incremento en sus capturas hasta 1987, año en que se obtienen 608,7 toneladas métricas con 26,2 kg/dp, en 1998, se observa una captura de 97,7 toneladas métricas con 12,3 kg/dp. Por el contrario, en 1990 los pataos y mojarras, especies de pequeña talla y bajo valor comercial, comienzan a desembarcarse para el consumo humano por su manifiesta abundancia, con 139,1 toneladas métricas y 8,8 kg/dp, y en 1997 alcanza un nivel de 694,1 toneladas métricas con 62,2 kg/dp.

En el caso específico de la biajaiba, teniendo en cuenta que la especie es explotada comercialmente por otras flotas y no existe una superposición manifiesta en las zonas de operaciones de las mismas, se realizó un estudio con el objetivo de definir la existencia de efectos negativos por parte de la pesquería de arrastre camaronero sobre sus poblaciones. El procesamiento de muestreos realizados entre 1992 – 1996 en áreas camaroneras, mostró que un 25% de los ejemplares capturados no habían alcanzado los 15 cm, correspondiente a la talla de primera maduración, lo cual pudiera producir una sobrepesca del reclutamiento.

Se concluye, que la población de esta especie en la zona suroriental se encuentra sobreexplotada como consecuencia del alto nivel de esfuerzo ejercido por la flota escamera, el deterioro de las zonas de cría y la influencia de la pesca de arrastre camaronero sobre los estadios juveniles de la misma.

### 5.2 Análisis sobre el efecto de la pesquería de arrastre camaronero sobre los fondos marinos

No se dispone de evidencias, a partir de los estudios realizados, acerca del efecto negativo que produce la tecnología de arrastre sobre los fondos marinos. Algunos autores plantean que puede modificar el hábitat, producir turbulencia y otras manifestaciones.

La intensidad de este efecto se encuentra directamente relacionada con el nivel de esfuerzo pesquero a que sea sometida el área de pesca.

Teniendo en cuenta las regulaciones, relativas a la reducción del esfuerzo pesquero aplicadas a la pesquería, se ha logrado una considerable disminución de este efecto.

Comparación de las veces que se arrastra toda el área de pesca del camarón, en relación con el esfuerzo real aplicado anualmente.

| AÑO | Días pesca | Número de veces que se arrastra el área total | AÑO | Días pesca | Número de veces que se arrastra el área total |
|---|---|---|---|---|---|
| **1982** | 38 290 | 10,8 | **1991** | 14 896 | 4,2 |
| **1983** | 32 775 | 9,2 | **1992** | 16 101 | 4,5 |
| **1984** | 29 835 | 8,4 | **1993** | 14 050 | 3,9 |
| **1985** | 25 701 | 7,2 | **1994** | 14 627 | 4,1 |
| **1986** | 24 542 | 6,9 | **1995** | 14 624 | 4,1 |
| **1987** | 23 186 | 6,5 | **1996** | 13 960 | 3,9 |
| **1988** | 21 261 | 6,0 | **1997** | 11 455 | 3,2 |
| **1989** | 21 185 | 6,0 | **1998** | 8 623 | 2,4 |
| **1990** | 15 896 | 4,5 | **Prom. 82-98** | 20 059 | 5,6 |

### 5.3 Significado socioeconómico de la fauna de acompañamiento de camarón (FAC)

Las principales incidencias en este sentido son:

- Afectación salarial, por reducción en las capturas de los pescadores directamente relacionados con la actividad extractiva, así como la reducción de puestos de trabajo en la industria y el pago de éstos por seguridad social.
- La pérdida de materia prima para la elaboración de productos con destino a la alimentación humana y animal, y su sustitución por productos importados.
- Pérdida de ingresos por comercialización de los productos derivados de la FAC.
- Costo de introducción de la nueva tecnología.
- Pérdida o subutilización de la inversión existente en la industria de procesamiento.
- Reducción en las capturas de camarón.
- Posible incremento en las interacciones ecológicas (depredación y competencia) determinado por la modificación en las estructuras poblacionales actuales, fundamentalmente sobre el camarón.

A pesar de las barreras socioeconómicas identificadas, las particularidades culturales e ideológicas de la población cubana permitirían una generalización rápida de estos dispositivos, luego de evaluar su beneficio sobre el medio ambiente y sus recursos naturales.

No obstante, para precisar una relación costo beneficio adecuada de la aplicación de nuevas prácticas en la pesquería de arrastre camaronero, más amigables con el medio ambiente, se requiere del desarrollo de una investigación especialmente diseñada, para evaluar la evolución de la aplicación de estrategias de uso o exclusión de la FAC, relativas a: el efecto sobre las pesquerías, las interrelaciones ecológicas y los aspectos socioeconómicos para las nuevas condiciones.

## 6. PROPUESTA DE ACCIONES

### 6.1 Carácter nacional

**Colecta de información biológica pesquera:**

- Programa de muestreo sistemático en el área de distribución del camarón.
- Programa de muestreo de las capturas, a bordo de embarcaciones camaroneras comerciales, así como de los desembarques en puerto.
- Cuantificación de los volúmenes de juveniles de peces de interés comercial capturadas en la pesca del camarón.

**Evaluación del efecto ecológico, económico y social que produce la introducción de BDRs en las pesquerías cubanas**

- Selección de los modelos de BDRs de mejores resultados internacionales y con posibilidades de adaptación a la tecnología utilizada en el país.
- Implementación de los BDRs a escala experimental.
- Cuantificación de las pérdidas de capturas de la especie objetivo y la fauna acompañante.
- Valoración del impacto ecológico, económico y social del uso extensivo de los BDRs.
- Programa de extensión para la generalización de estos dispositivos entre las comunidades y directivos de la pesca.

**Estudio de la estructura de las comunidades demersales, mediante la aplicación de análisis multidimensional**

- Estudio de las variaciones estacionales y espaciales de la composición de la fauna de acompañamiento.
- Definir el efecto de la intensidad del esfuerzo pesquero como factor principal en las variaciones de la estructura por especie.

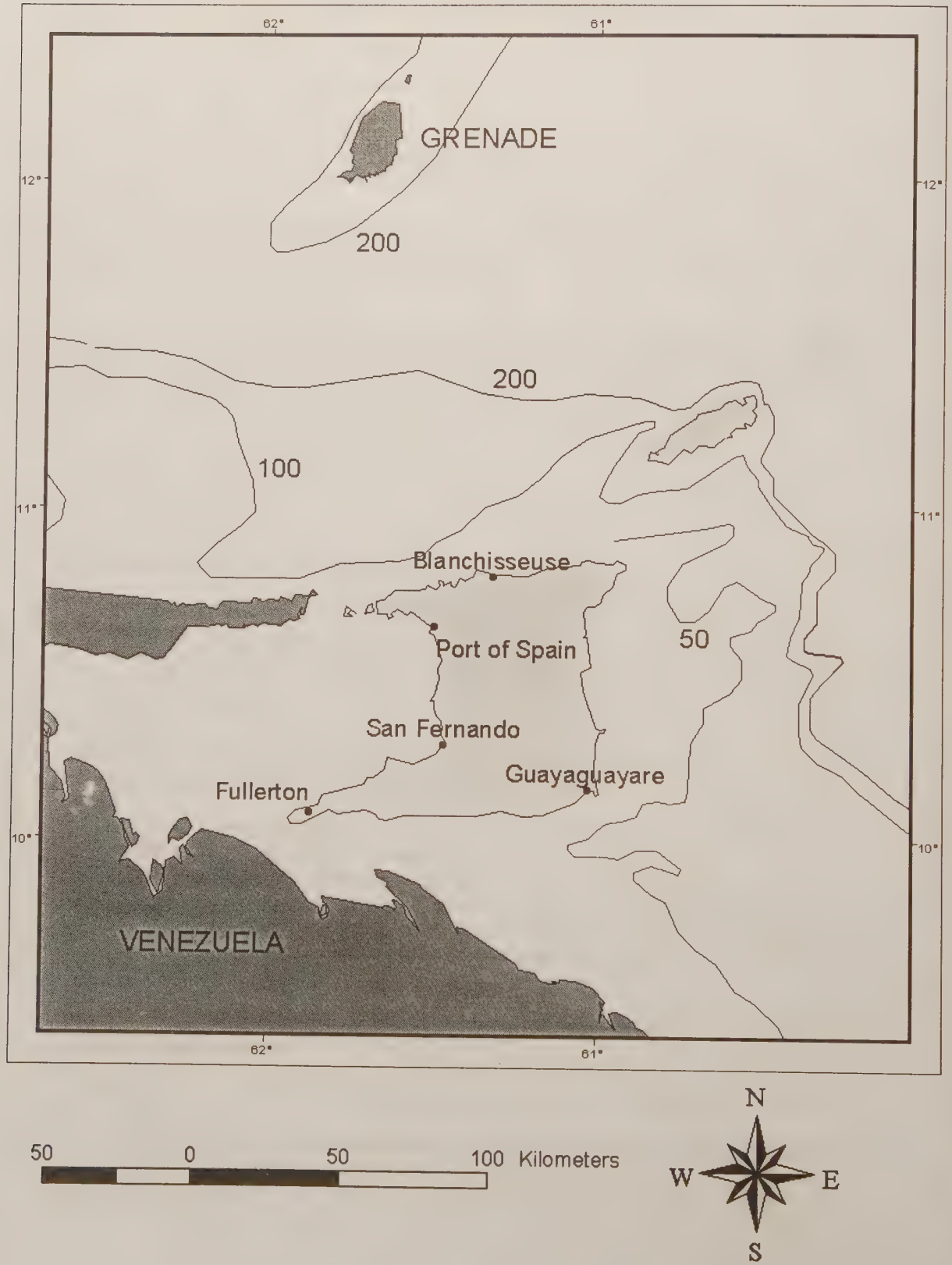
## 6.2 Carácter regional y general

- Fortalecimiento de un sistema de base de datos que permita tener un mayor conocimiento de las capturas incidentales, de su uso, y los volúmenes descartados.
- Intercambio de información y experiencia científica y técnica, para la reducción de la captura incidental y su aprovechamiento como fuente proteica.

**TRINIDAD Y TOBAGO**

**IMPACT OF SHRIMP FISHERIES IN TRINIDAD AND TOBAGO**

National report presented at the Regional Workshop held in Costa Rica; 14-14 January, 2000
By Ms. Sita Kuruvilla; National Coordinator (Ministry of Agriculture Land and Marine Resources Fisheries Division; N.H.A. Building South Quay; Port of Spain; **Trinidad and Tobago;** Fax: 634-4488, 623-8542; E-mail: mfau2fd@tstt.net.tt )



Abstract

The annual landings of shrimp are approximately 1 000 t with as main species: *Penaeus brasiliensis* (hoppers), *P. notialis* (pink shrimp), *P. schmitti* (white/cork shrimp), *P. subtilis* (brown shrimp) and *Xiphopenaeus kroyeri* (honey/jinga shrimp).

Fish is targeted by shrimp trawlers when there is demand from the market or during the wet season when shrimp abundance decreases.

A significant quantity of finfish, squid and crabs are caught as by-catch, and some species of finfish may be targeted according to market demand, or

The by-catch landed is only a portion of that captured, the rest is discarded at sea: according to several recent studies, smaller trawlers are discarding almost all, semi-industrial trawlers about 60% and the industrial outrigger trawlers about two thirds (by weight).

Products sold locally include fresh chilled shrimp, peeled and breaded shrimp, exports are mainly fresh-chilled or frozen shrimp.

The trawling fleet numbers 126 vessels (in 1998), 19 of which are industrial outrigger trawlers, normally fishing in deeper waters (40 to 60 m depth). The semi-industrial and industrial trawlers have Turtle Exclusion Devices (TEDs) on their trawls.

Regulations specify the areas where trawl activity can occur with regard to depths and distance from the coastline as related to vessel type. The minimum mesh sizes in the codends of the trawl is 35 mm for shrimp and 75 mm for fish.

National management initiatives include the development and strengthening of national monitoring capabilities through the introduction of logbooks. Observer programmes exist for the monitoring of the offshore fisheries and detailed bio-economic analysis are regularly carried out on the main components of the trawl fishery.

The main problems reported include: overfishing, capture and discarding of juvenile shrimp and fish, conflict between trawling and other fishing methods, the impact of trawling on the bottom habitat. Development and introduction of a combined turtle and fish excluder is given high priority.



Resumen

Los desembarcos anuales alcanzan aproximadamente las 1.000 toneladas métricas y las principales especies son: *Penaeus brasiliensis* ("hoppers"), *P. notialis* (camarón rosado), *P. schmitti* (camarón blanco o "cork shrimp"), *P. subtilis* (camarón marrón) y *Xiphopenaeus kroyeri* (camarón miel / camarón jinga).

Los arrastreros camaroneros capturan pescado cuando aumenta su demanda en el mercado o durante la estación lluviosa, cuando disminuye la abundancia del camarón.

Una cantidad significativa de pescado, calamar y cangrejo es capturada como fauna de acompañamiento, mientras que otras especies de pescado son capturadas según la demanda del mercado.

La fauna de acompañamiento desembarcada constituye sólo una porción del total capturado, el resto es descartado en el mar. Según estudios recientes, los pequeños arrastreros descartan casi todo, los arrastreros semi-industriales cerca de un 60% y los arrastreros industriales con tangones, alrededor de dos tercios (en peso).

Los productos que se venden localmente incluyen camarón fresco refrigerado, camarón pelado y empanizado, las exportaciones son básicamente de camarón fresco refrigerado o congelado.

En 1998, la flota de arrastre estaba constituida por 126 embarcaciones, de las cuales 19 eran arrastreros industriales con tangones, que normalmente faenan en aguas profundas (40 a 60 metros de profundidad). Los arrastreros semi-industriales e industriales cuentan con dispositivos exclusores de tortugas (TED) en sus redes.

Las regulaciones especifican las áreas donde puede efectuarse la pesca de arrastre según la profundidad y la distancia de la costa, así como también, del tipo de embarcación. La abertura de malla mínima permitida en el copo de la red es de 35 mm para camarón y 75 mm para pescado.

Las iniciativas para el manejo nacional incluyen el desarrollo y el fortalecimiento de la capacidad de vigilancia, mediante la introducción de bitácoras. Existen programas de observadores para la vigilancia de la pesca en al alta mar y regularmente se efectúan análisis bioeconómicos detallados en relación con los principales componentes de la pesca de arrastre.

Los principales problemas reportados incluyen: sobre pesca, captura y descarte de camarones y peces juveniles, conflictos entre la pesca de arrastre y otros métodos, el impacto del arrastre en el hábitat del fondo marino. Se le ha dado alta prioridad al desarrollo y a la introducción de dispositivos combinados para la exclusión de tortugas y peces.

## 1. INTRODUCTION

The ecology of the marine environment of Trinidad and Tobago is influenced by the major freshwater and oceanic systems in the region. The river systems of northeast South America, have an important seasonal effect on the area of the continental shelf on which the islands are situated and the marine areas southwest of Trinidad which are particularly influenced by the outflow of the Orinoco river exhibit an estuarine environment. The oceanic North and South Equatorial currents, create a more oceanic environment off the north east and in the Exclusive Economic Zone.

The continental shelf off the south, east, north and west coasts exhibits different ecological regimes, the Columbus Channel in the south can be considered an extension of the Orinoco Delta and is dominated by the seasonal discharges of the river. The Orinoco regime extends up along the inner parts of the east coast shelf, but offshore, there is the greater influence of the Guiana current. The north coast shelf is located at the origin of the Caribbean Current and with an inshore upwelling system is an area of relatively high productivity (IMR, Bergen, 1989). The Gulf of Paria off the west coast is a slightly stratified, semi-enclosed zone where outflows from the Orinoco and other rivers mix with water from the open ocean (Gines 1972). The combined effect of these oceanographic regimes and topographic features is a great diversity and seasonality in the marine fisheries resources.

Five species of penaeid shrimp are of commercial importance to both the artisanal and industrial fisheries of the northeast South America continental shelf. These are short-lived species (1-2 years), with a life cycle that includes an estuarine phase of development for the larval shrimp. After emigrating from estuaries as juveniles or sub-adults, the shrimp move into progressively deeper waters further from the coast where they complete there development, and spawn. The shrimp trawl fisheries of the region are therefore often described as gauntlet fisheries, where the shrimp are harvested at different stages in the life cycle by an inshore artisanal fleet and an offshore industrial fleet.

The demersal trawl fishery of Trinidad and Tobago developed in the early 1960's as an artisanal fishery targeting mainly the white shrimp *Penaeus schmitti* off the southwest coast of Trinidad and in the inshore waters of the Orinoco Delta on the coast of Venezuela. In 1977, the first official Fishing Agreement was signed between Trinidad and Tobago and Venezuela permitting access to sixty artisanal trawlers to inshore areas of the Delta. In 1985 the Agreement was renegotiated, permitting 70 artisanal vessels to operate under specified conditions in the Orinoco Delta for a seven month season. The vessels operated out of sites in the southwest peninsula of Trinidad and returned to base daily to sell their catch. Access to the Orinoco Delta shrimp fishery was terminated in 1995 and these vessels have largely retooled for other forms of inshore fishing. There are currently 71 artisanal trawl vessels operating in the Gulf of Paria out of sites along the West Coast.

In addition to the artisanal fleet, there were nine Gulf of Mexico-type industrial trawlers fishing locally in 1969 and a fleet of foreign registered industrial trawl vessels fishing off Guyana, Suriname, French Guiana and Brazil and landing their catch in Trinidad for processing and export (Wood, 1977). During the period 1972 to 1979, the State-owned National Fisheries Company processed and exported shrimp from its fleet of 24 industrial trawlers. In addition, the company purchased shrimp and fish from vessels owned by nationals and from foreign-based trawlers fishing on the continental shelf of northeast South America. After 1985, the company disposed of its trawlers, some of which were bought by nationals of Trinidad and Tobago and entered the local fishery. There are currently 10 semi-industrial stern drag trawlers and 19 industrial trawlers in the local fleet.

The shrimp trawl fishery of Trinidad and Tobago is considered to be one of the country's more valuable fisheries, with the artisanal and semi-industrial fleets accounting for approximately 17% by weight and 11% by value of the total annual production of the country's artisanal fleet in 1996. Estimated landings for the artisanal and semi-industrial fleets in 1996 were 440mt of shrimp valued at US$1.00m and 281mt by-catch valued at US$0.2m. Estimated landings for the industrial fleet was 994 metric tonnes for 1995.

## 2. THE SHRIMP FISHERY

### 2.1 Shrimp resources (Species, area distribution, Figure 1 stock sizes etc.)

It is difficult to distinguish the extent of the shrimp stocks around Trinidad that originate in local wetlands from the extent that migrate into the area from South American nursery areas. It is certain that larval drift and other dispersion processes contribute to some extent. However, survival of drift larvae has never been studied. A 1978 estimate, calculated using shrimp production data from various countries, places the potential annual shrimp production of Trinidad at 37 kg per hectare of mangrove (Turner, 1974 from Ramcharan *et al.* 1982). Mangroves occupy a total of 8000 ha in Trinidad, giving an estimated annual shrimp production of 296 000 kg, or 300 tonnes. The actual shrimp production was in the order of 1780 tonnes in 1991 (Fabres and Kuruvilla 1992). The discrepancy between these figures could be at least in part as a result of the contribution of larvae and juveniles from the continental shelf. However, it is uncertain if other productive habitat like marsh and seagrass beds were fully taken into account in the production of the figures from Turner (1974).

In Trinidad and Tobago and the Guyanas, there are five (5) species of shrimp of the family Penaeidae which are exploited commercially: *Penaeus notialis* (pink shrimp), *P. subtilis* (brown shrimp), *P. schmitti* (white or cork shrimp), *P. brasiliensis* (hoppers) and *Xiphopenaeus kroyeri* (honey or jinga shrimp or sea bobs. Dragovich et al.(1980) described *P.subtilis, P. brasiliensis* and *P. notialis* as eulittoral and sublittoral, mainly marine animals, and *P. schmitti* and *X. kroyeri* as eulittoral, euryhaline animals, based on their observed depth ranges and frequency of occurrence at different salinities.

On the Guyana/ Brazil continental shelf *P. subtilis* has been observed at depths from 12.8 to 91 m, *P. brasiliensis* from 30 to 90 m, and *P. notialis* from 27 to 62 m. *P. schmitti* and *X. kroyeri* are found in shallower waters, *P. schmitti* between 4 and 48 m, and *X. kroyeri* between 4 and 44 m (Dragovich et al, 1980; Garcia and Le Reste, 1981), resulting in significant overlap in distribution with soft-bottomed fishes of various groups.

Analysis of shrimp samples collected from commercial landings from 1991 to 1996 show that landings from artisanal trawlers operating inshore in the Gulf of Paria are composed of similar proportions of *P. notialis* and *P. schmitti*. *P. subtilis* and *X. kroyeri* are landed in small amounts. Generally, *P. brasiliensis* is rarely found in artisanal trawl landings. These analyses also show that landings from semi-industrial trawlers operating in the nearshore Gulf of Paria are composed mainly of *P. notialis* (71% total landings), and small amounts of *P. schmitti* and *P. subtilis*. No *P. brasiliensis* or *X. kroyeri* are landed.

Analyses of commercial landings for 1991 to 1992 (Maharaj et al 1993) show that industrial trawlers operating offshore in the Gulf of Paria land mainly *P. notialis* (60% total landings) and *P. subtilis* (31% total), with small amounts of *P. brasiliensis*. *P. schmitti* is rare, while *X. kroyeri* is absent from landings. Industrial vessels trawling in the Columbus Channel land mostly *P. subtilis* (51% total landings). *P. brasiliensis* and *P. notialis* are also abundant. No *X. kroyeri* is landed. No information is available on the species composition of shrimp catches from the north coast.

## 2.2 Fishing methods (Vessel and gear)

The trawl fleet comprises a total of 112 vessels: 84 artisanal (based on a vessel census conducted in 1998 by the Fisheries Division of Trinidad (Chan A Shing 1999)); 8 semi-industrial and 20 industrial (based on Fisheries Division records as at 1999). Table 1 outlines the characteristics of the fishing fleets in the shrimp trawl fishery.

The artisanal fleet lacks on-board storage facilities or electronic equipment. The catch is kept on ice in covered barrels which are also used to transport the catch to the market. These vessels are constructed of wood or fibreglass and carry one inboard engine.

The semi-industrial fleet usually have electronic fishing aids, communication equipment and a fish/ice hold. Type IV vessels represent the industrial fleet and are Gulf-of-Mexico (double-rigged) type trawlers are outfitted with fishing aids (echo sounder), communication (CB, VHF and SSB radio) and refrigeration equipment. Both the semi-industrial and industrial fleets carry inboard diesel engines and fixed, steel shafted propellers. There are no on-board facilities for processing.

**Figure 1: Areas exploited by the various fleets**

**TABLE 1: Characteristics of an average fishing vessel in each of the three categories of trawlers.**

| Type of trawler | Fleet Size | Length (m) | Tonnage* (tons) | Engine Power (Hp) | Onboard facilities/Storage | Gear/Deck equipment |
|---|---|---|---|---|---|---|
| Artisanal (I and III) | 71 | 7.9-10.4 | - | 90-110 | Portable barrels with ice with an average capacity for 41 kg of fish/shrimp | 1.3 x 0.5 m doors, net 14.7 m long with headrope length-10.7m, mesh size- 3.5cm. |
| Semi-industrial (III) | 10 | 9.3-13.1 | | 165-174 | Ice hold with storage capacity of 8 tons | 1.9 x 0.9 m doors, net 15-17 m long with headrope length-12.9m, mesh size- 3.5cm. Winch, fishing aids and communication equipment. |
| Industrial (IV) | 19 | 18.7-24.3 | 30-96 | 365 | Refrigerated fish hold. Ice hold capacity –22 tons | 12 x 2.7 m doors, net 14.7 m long with headrope length-15m, mesh size- 3.5cm. Winch, fishing aids and communication equipment. |
| * Gross Registered Tonnage (GRT) | | | | | | |

All trawlers use four-seamed, flat nets. Artisanal trawlers use one stern trawl which is set and retrieved manually. Semi-industrial trawlers have one stern trawl which is operated with a hydraulic winch, while industrial trawlers use two nets attached to twin outriggers, and which are set and retrieved using a hydraulic (double-drum) winch.

### 2.3 Fishing grounds, practices and effort

The fishing grounds around Trinidad are located in fishing area 31 of the FAO major fishing area coding system (FAO 1972). All fleets operate in the Gulf of Paria on Trinidad's West Coast. In addition, the industrial fleet operates in the Columbus Channel south of the island, as well as on the north west of Trinidad. The areas and depths exploited by the various fleets are given in Figure 1 and Table 2. Some of the fishing grounds, namely the Gulf of Paria and the Columbus Channel are also exploited by Venezuelan trawlers.

**TABLE 2: Areas exploited by the trawler fleets (Interviews with fishermen 1997; Maharaj, Ferreira, and Lum Young 1993)**

| Vessel Type | Region Fished | Depths (m) | Area of Ground ($km^2$) |
|---|---|---|---|
| Artisanal | Gulf of Paria | 1.8 - 18.0 | 607 |
| Semi-industrial | Gulf of Paria | 9.0 - 41.4 | 1,793 |
| Industrial | North Coast | 37.8 - 57.6 | 184 |
| | Gulf of Paria | 9.0 - 48.6 | 1,269 |
| | Columbus Channel | 18.0 - 41.4 | 1,740 |

Trawling occurs all year round in the Gulf of Paria (for artisanal, semi-industrial, and industrial) and in the Columbus Channel off the south coast (industrial trawlers). For industrial vessels the main fishing season runs from May to August in the Gulf of Paria and from October to March on the south coast. In addition, some industrial vessels trawl off the north coast of Trinidad between the months of November to January. Vessels operating in the coastal waters of Trinidad trawl both day and night. For artisanal

vessels, an average fishing trip lasts for eight hours but is recorded as one day. The average artisanal vessel has a crew for the day operations and another for the night. The average fishing trip for a semi-industrial vessel is 21 hours and is also recorded as a one-day trip. The average fishing trip for industrial vessels is fifteen days of which two days are used for travelling to and from the fishing grounds.

Table 3 gives the operational characteristics of an average fishing vessel in each of the four categories of trawlers.

**TABLE 3: Operational characteristics of each trawler type**

| Trawler Category | Average Number of Fishing days /Month/Vessel | Average Number of Hauls/Day | Average Duration of Haul (Hours) | Average Vessel Speed (knots) |
|---|---|---|---|---|
| Artisanal | 13 | 4 | 2 | 1 |
| Semi-industrial | 16 | 5 | 3 | 2 |
| Industrial | 17 | 3 | 3 | 3 |

*Source: Interviews with fishermen 1999; Extrapolation from Trawler Logbooks1991-92; Ferreira 1998.*

The average number of fishermen on board an artisanal vessel is two. Generally, the average number of crew (including the captain) for semi-industrial and industrial vessels is three and four respectively. Based on the results of a census conducted in 1998, there are some 244 fishermen actively involved in the local trawl fishery (Chan-A-Shing, 1999 Of this, 142 work full-time on artisanal trawlers, 30 on semi-industrial and 72 on industrial trawlers.

The average artisanal trawler is owned by one individual and the vessel is generally operated by a family relation of the owner. The average semi-industrial and industrial trawler is also owned by one individual and the captain is usually a trained seaman. In many instances an individual may own more than one vessel within a fleet or across fleets.

Trawling in Trinidad and Tobago is almost entirely single trawling. Vessels may however join occasionally to carry out some pair trawling when shrimp or fish aggregations occur.

The estimated fishing effort for each of the trawl fleets for 1987 to 1996 is given in Table 4. These data were used to calculate the area swept by each of the fleets for the period 1992 to 1996, and these results are given in Table 5.

**TABLE 4: Estimated fishing effort (days) for the trawl fishery for the period 1987 to 1996***

| Year | Artisanal | Semi-industrial | Industrial |
|---|---|---|---|
| 1987 | 17,581 | 4,598 | N/A |
| 1988 | 18,093 | 3,819 | N/A |
| 1989 | 12,687 | 3,472 | N/A |
| 1990 | 19,090 | 4,351 | N/A |
| 1991 | 16,226 | 3,911 | 3,347 |
| 1992 | 16,138 | 2,326 | 4,043 |
| 1993 | 15,061 | 2,197 | 3,870 |
| 1994 | 14,463 | 2,129 | 4,845 |
| 1995 | 20,946 | 2,497 | 4,355 |
| 1996 | 13,433 | 1,752 | N/A |

**The method of estimating fishing effort by trawler fleet was refined from 1992 onward.*

**TABLE 5: Area swept ($km^2$) by trawler category for 1992 to 1996**

| Year | Artisanal | | | | Semi-industrial | Industrial | Total |
|---|---|---|---|---|---|---|---|
| | Venezuela | Gulf of Paria | | Total | | | |
| | Types I & II | Type I | Type II | | | | |
| 1992 | 154 | 106 | 2,042 | 2,301 | 965 | 3,616 | 6,883 |
| 1993 | 219 | 140 | 1,599 | 1,958 | 912 | 3,461 | 6,331 |
| 1994 | 158 | 209 | 1,589 | 1,956 | 884 | 4,333 | 7,173 |
| 1995 | 465 | 129 | 1,809 | 2,403 | 1,036 | 3,895 | 7,334 |
| 1996 | 166 | 71 | 1,603 | 1,840 | 727 | - | 2,567 |

## 2.4 Shrimp catches (Historical development of the fishery by species)

The demersal trawl fishery of Trinidad and Tobago developed in the early 1960's as an artisanal fishery targeting mainly the white shrimp *Penaeus schmitti*. Jordan (1969), recorded an increase in the numbers of artisanal trawlers registered with the Fisheries Division from 66 in 1966 to 166 in 1969. These vessels operated out of sites on the west coast of Trinidad, and fished mainly off the southwest coast of Trinidad and in the inshore waters of the Orinoco Delta on the coast of Venezuela. In 1977, the first official Fishing Agreement was signed between Trinidad and Tobago and Venezuela permitting access to sixty artisanal trawlers to inshore areas of the Delta.

Chin Yuen Kee (1984), described the local trawl fishery as comprising 250 artisanal vessels, 22 Gulf of Mexico type trawlers, three (3) combination fish/shrimp trawlers and eight (8) semi-industrial stern trawlers. In 1985, the bilateral fishing Agreement with Venezuela was renegotiated permitting 70 of the 113 artisanal vessels to operate under specified conditions in the Orinoco Delta for a seven month season. The vessels operated out of sites in the southwest peninsula of Trinidad and returned to base daily to sell their catch. Access to the Orinoco Delta shrimp fishery was terminated in 1995, and this fleet has largely retooled for other forms of inshore fishing. The artisanal fleet based in the Gulf of Paria continued to operate.

In addition to the artisanal fleet, there were nine Gulf of Mexico-type industrial trawlers fishing locally in 1969 and a fleet of foreign registered industrial trawl vessels fishing off Guyana, Suriname, French Guiana and Brazil and landing their catch in Trinidad for processing and export (Wood, 1977). During the period 1972 to 1979, the State-owned National Fisheries Company processed and exported shrimp from its fleet of 24 industrial trawlers. In addition, the company purchased shrimp and fish from vessels owned by nationals and from foreign-based trawlers fishing on the continental shelf of northeast South America. Between 1977 and 1985, the availability of shrimp and fish to the company fluctuated, and was dependent on the ability of the Government to obtain access for the industrial fleet, to the shrimp grounds off Brazil through bilateral Agreements or joint venture arrangements (Meyers, 1996). After 1985, the company disposed of its trawlers, some of which were bought by nationals of Trinidad and Tobago and entered the local fishery.

In 1988, a Government decision to limit the expansion of the trawl fishery placed a freeze on the numbers of vessels in all components of the fishery. The fleet sizes for the semi-industrial and industrial trawlers have fluctuated around the levels established in 1988.

The monitoring of shrimp catches for the artisanal and semi-industrial fleets is part of the established system of port sampling for the artisanal fishery, for which there is a long time series of data available. The system for sampling of the industrial fleet established in 1991, has however failed, and shrimp catches for this fleet are based on raised data from the few vessels sampled.

**TABLE 6: Estimated shrimp landings (metric tonnes) for 1987 - 1996***

| Year | Artisanal Trawlers | Semi-industrial (Stern Drag) Trawlers | Industrial Trawlers** | Total |
|---|---|---|---|---|
| 1987 | 921 | 375 | N/A | - |
| 1988 | 605 | 173 | N/A | - |
| 1989 | 329 | 109 | N/A | - |
| 1990 | 653 | 162 | N/A | - |
| 1991 | 618 | 162 | 1000 (est.) | 1780 |
| 1992 | 402 | 93 | 591 | 1086 |
| 1993 | 486 | 84 | 603 | 1173 |
| 1994 | 403 | 97 | 857 | 1357 |
| 1995 | 688 | 134 | 994 | 1816 |
| 1996 | 378 | 62 | N/A | - |

**The method of estimating landings by trawler category was refined from 1992 onward.*
***There are no foreign trawl fleets operating out of Trinidad and Tobago, all vessels belong to the local fleet.*

Table 7 indicates shrimp landings by species for 1992-1996 based on biological sampling of landings from 1991-1992 for the industrial fleet and 1992-1996 for all other fleets.

**TABLE 7: Estimated shrimp landings (metric tonnes) by species for 1992-1996**

| | | Artisanal | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Venezuela | Gulf of Paria | | | Semi- | | |
| Year | Item | Types I & II | Type I | Type II | Total | industrial | Industrial | Total |
| 1992 | *P. subtilis* | 59 | 2 | 24 | 85 | 15 | 279 | 379 |
| | *P. schmitti* | 87 | 7 | 85 | 179 | 10 | 0 | 189 |
| | *P. notialis* | 0 | 5 | 84 | 89 | 67 | 151 | 306 |
| | *X. kroyeri* | 0 | 6 | 44 | 50 | 0 | 0 | 50 |
| | *P. brasiliensis* | 0 | 0 | 0 | 0 | 1 | 161 | 162 |
| | **Total** | 146 | 20 | 236 | 402 | 93 | 591 | 1,086 |
| 1993 | *P. subtilis* | 100 | 4 | 22 | 125 | 17 | 285 | 427 |
| | *P. schmitti* | 135 | 9 | 70 | 214 | 5 | 0 | 219 |
| | *P. notialis* | 0 | 7 | 59 | 66 | 62 | 154 | 281 |
| | *X. kroyeri* | 0 | 9 | 71 | 81 | 0 | 0 | 81 |
| | *P. brasiliensis* | 0 | 0 | 0 | 0 | 0 | 164 | 165 |
| | **Total** | 235 | 29 | 222 | 487 | 84 | 603 | 1,174 |
| 1994 | *P. subtilis* | 89 | 6 | 34 | 129 | 18 | 405 | 552 |
| | *P. schmitti* | 63 | 19 | 51 | 133 | 12 | 0 | 145 |
| | *P. notialis* | 0 | 13 | 37 | 50 | 66 | 219 | 335 |
| | *X. kroyeri* | 1 | 14 | 74 | 89 | 0 | 0 | 89 |
| | *P. brasiliensis* | 0 | 0 | 1 | 1 | 1 | 233 | 236 |
| | **Total** | 154 | 52 | 197 | 402 | 97 | 857 | 1,356 |
| 1995 | *P. subtilis* | 247 | 3 | 35 | 286 | 23 | 470 | 779 |
| | *P. schmitti* | 147 | 10 | 78 | 235 | 16 | 0 | 251 |
| | *P. notialis* | 2 | 7 | 45 | 55 | 94 | 254 | 402 |
| | *X. kroyeri* | 5 | 7 | 101 | 113 | 0 | 0 | 113 |
| | *P. brasiliensis* | 0 | 0 | 1 | 1 | 1 | 271 | 273 |
| | **Total** | 401 | 27 | 260 | 689 | 134 | 994 | 1,817 |
| 1996 | *P. subtilis* | 87 | 2 | 39 | 128 | 11 | N/A | 139 |
| | *P. schmitti* | 67 | 4 | 75 | 147 | 5 | | 152 |
| | *P. notialis* | 3 | 3 | 28 | 34 | 44 | | 79 |
| | *X. kroyeri* | 4 | 4 | 62 | 69 | 0 | | 69 |
| | *P. brasiliensis* | 0 | 0 | 1 | 1 | 1 | | 2 |
| | **Total** | 161 | 13 | 204 | 378 | 62 | | 440 |

## 2.5 By-catch (species andsize composition) and its utilization (see Appendix I)

A significant quantity of finfish (also referred to as groundfish) and crabs are caught as by-catch in the trawl fishery. Certain species of groundfish may be targeted according to market demand, or during the wet season when shrimp abundance decreases. The finfish of commercial importance commonly caught by trawling belong to the families Sciaenidae, Clupeidae, Gerreidae, Lutjanidae, Engraulidae, Haemulidae and Ariidae as well as Portunid crabs. The main species of commercial importance landed by the trawl fleets are *Micropogonias furnieri* (croaker), *Cynoscion jamaicensis, C. acoupa* and *Macrodon ancylodon* (weakfish), *Diapterus spp* (blinch), *Haemulon* spp, *Genyatremus luteus*, and *Orthopristis spp* (grunts), *Lutjanus spp*, and *Rhomboplites aurorubens* (snappers), and *Arius spp* (catfish). Clupeids such as *Sardinella* spp., *Anchoa* spp and *Cetengraulis* spp. are landed occasionally, based on seasonal abundance, by the artisanal fleet only.

A study of the artisanal trawl fishery conducted between August 1986 and May 1987 identified 70 species of fin-fish from 40 families in the by-catch, as well as several species of Portunid crabs. Of the fish caught, commercially important species accounted for only 15-33% of the total finfish catch (Maharaj, 1989). The by-catch to shrimp ratio was 15:1 and the finfish:shrimp ratio was 9:1. It was estimated that approximately 94% of the by-catch of artisanal trawlers was discarded in 1986. Commercial landings statistics for the period 1987-1991 indicate that the by-catch landed by artisanal vessels is comprised of *Sardinella brasiliensis, Anchoa sp., Diapterus sp., Lutjanus sp., Micropogonias sp.* and Portunid crabs. A large quantity of juvenile fin-fish of several different species are also landed as 'mixed fish'.

In a one month study of the semi-industrial trawl fishery, Amos (1990) identified 25 species of fin-fish in the by-catch, from 14 families. The most abundant families were the Carangidae, Gerreidae, Lutjanidae, Sciaenidae, Triglidae and Portunidae. Approximately 60% of the fin-fish caught during this study was discarded and the by-catch:shrimp ratio was estimated at 12:1 and the finfish:shrimp ratio was within the range of 5-10:1. The by-catch landed by semi-industrial trawlers during the period 1987-1991 consisted of *Harengula jaguana, Opistonema oglinum, Lutjanus sp., Cynoscion sp., Micropogonias sp.,* Portunid crabs and juveniles of the species listed above. Length frequency analyses for two of the most commercially important and abundant species, Micropogonias furnieri and Cynoscion jamaicensis, indicated that for both species over 95% of the individuals sampled were immature.

An update to the studies on the artisanal and semi-industrial fisheries (Maharaj 1989 and Amos 1990 respectively) was initiated by the Fisheries Division in July 1999. From analyses of the total catches of artisanal vessels, 30 species of fin-fish from 20 families and several species of Portunid crabs were observed in the by-catch. An estimated 92% of the by-catch of artisanal vessels is discarded and the by-catch:shrimp ratio was 16:1. From analyses of the total catch of semi-industrial vessels, 26 species of fin-fish from 18 families were identified in the by-catch. Approximately 69% of the by-catch of the semi-industrial fleet is discarded and the by-catch:shrimp ratio for this fleet is estimated at 11:1. The composition of the by-catch landed by artisanal and semi-industrial vessels in this study is similar to that of previous studies with the most common families being Carangidae, Gerreidae, Lutjanidae, Sciaenidae, Triglidae and Portunidae. These results are preliminary since the study is still in progress and will also include catches from the industrial fleet.

Analysis of industrial logbook returns for November to December 1991, indicate that 65% of the total by-catch is discarded. An estimated value of finfish:shrimp obtained from landing statistics for the period 1992-1996 is 1.7:1. These vessels land mainly *Decapterus sp., Diapterus rhombeus, Lutjanus sp., Cynoscion sp., Micropogonias sp.,* several types of Sharks and 'mixed fish'. Details of the species composition of discards for the industrial fleet is not available but from logbook returns it was indicated that some of the commercially important species were discarded.

Discards from the artisanal and semi-industrial fleet are primarily clupeids, engraulids and juvenile sciaenid and gerrid species and portunid crabs. Juvenile flounders (Bothidae), sole (Soleidae) and catfish are also commonly discarded but they have little or no commercial importance in the local fishery.

Appendix I is a list of species identified in catches from the artisanal and semi-industrial fleets compiled from Maharaj (1989), Amos (1990) and the current survey of the Fisheries Division. Figure 2 gives the percentage composition of species present in the bycatch landed by all trawl fleets.

Groundfish is landed by all trawl fleets as either 'choice fish' or 'mixed fish' based on the size of the fish and both categories are comprised of the commercially important finfish already mentioned. 'Choice fish' is larger fish and has a higher market value than the 'mixed fish' which is smaller sized fish and juveniles. The "choice fish" category landed by artisanal vessels is 20 cm to 30 cm in length while the 'mixed fish' category is 8 cm to 22 cm. For the semi-industrial fleet 'choice fish' ranges from 16 cm to 32 cm while 'mixed fish' ranges from 9 cm to 22 cm in length. For the industrial fleet, the "choice fish" landed ranges from 28 cm to 54 cm in length while the 'mixed fish' ranges from 10 cm to 28 cm.

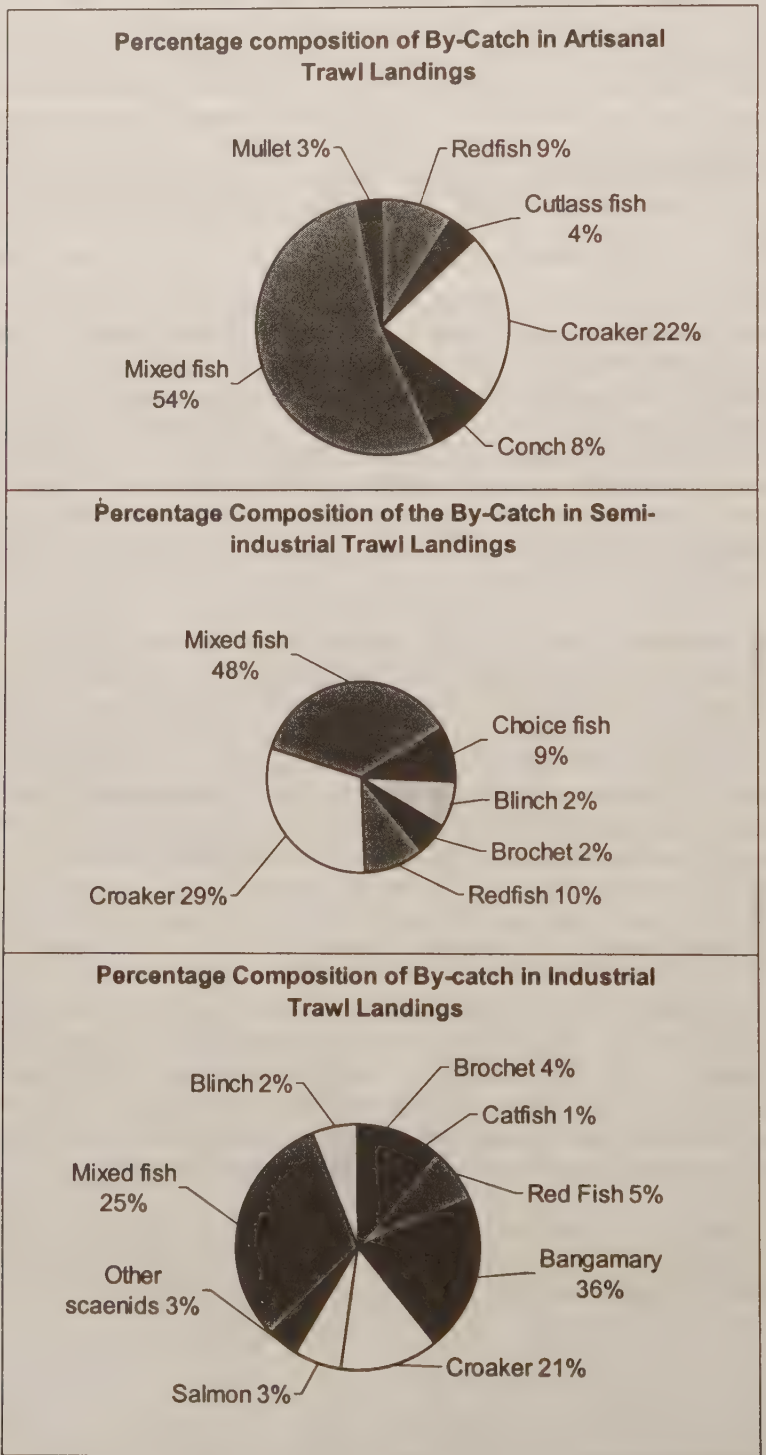



**Figure 2: Percentage composition of species in bycatch landed by all trawl fleets**

By-catch is sold fresh or chilled on the beaches to the householder, retail vendors, wholesalers and fish processors. Vendors may sell in retail markets and/or along the highways. 'Choice fish' is generally sold by wholesalers to fish processors, restaurants, and privately-owned fish processing companies which prepare fish for sale in supermarkets and the export market. 'Mixed fish' is sold in rural areas. Local markets are supplied with fresh fish on ice or a processed product, while the foreign markets receive the chilled or frozen product. The traditional export markets for fish are the U.S., U.K. and Canada.

### 2.6 Distribution of catches (Inland or export market)

Exports from the local industry have risen from 288 metric tonnes valued at TT$6.3 million in 1992 to 500 metric tonnes valued at TT$ 17.6 million in 1995. This increase is accounted for mainly by the demand from the United States, which accounted for 67% of the exports in 1995. Shrimp exports declined after 1995 to 163 metric tonnes in 1998, valued at TT$10 million with 96% of the exports going to CARICOM countries (Figure 3). The local market for shrimp has grown with the rise in tourism and the growth of the local economy which has supported sales to restaurants and hotels. Data is currently unavailable from the existing local distribution system.

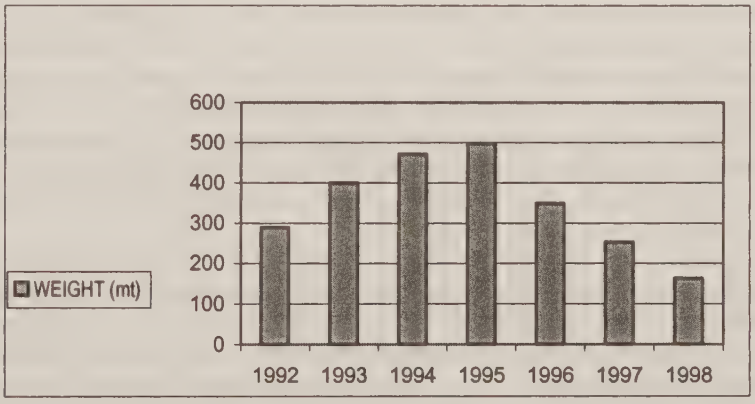



**Figure 3: Shrimp exports by weight for 1992 to 1998**

The industry is now facing increasingly stringent quality control measures for exports of fish and fish products to the European Union and United States. In addition exports of shrimp to the United States (US) have been banned since March 1999 pending full compliance with US Laws on the use of Turtle Excluder Devices (TED's).

## 3. REGULATIONS AND MANAGEMENT MEASURES
**(Including use of selective devices, closed areas, closed seasons, etc.)**

The legislative basis for management of domestic fishing is the *Fisheries Act 1916*, and the subsequent amendments to the Act, the *Fisheries (Amendment) Act 1966*, and the *Fisheries (Amendment) Act 1975*. The Act applies to all rivers and tidal waters in Trinidad and Tobago and to the 12 mile territorial sea. It does not apply to the Exclusive Economic Zone (EEZ).

The Act is limited in scope and merely empowers the Minister to make regulations controlling the mesh size, form and dimensions of nets and appliances for fishing, and the manner of their use, setting minimum species sizes for species that may be fished or sold, declaring prohibited areas for fishing, prohibited fishing for specified species, either absolutely or by season or area, and prohibiting the sale of fish or any species of fish, again either absolutely or by season or area. Sanctions of TT$ 2,000 (US$ 323) or six months imprisonment are provided for most infractions.

The *Marine Areas (Preservation and Enhancement) Act 1970*, provides for the designation of restricted areas. The *Marine Areas (Preservation and Enhancement) Regulations 1973*, require the permission of the Minister to enter and remove fauna from the restricted area. The Act is currently applied only to the management of coral reefs.

The *Archipelagic Waters and Exclusive Economic Zone Act of 1986* provides for the declaration of archipelagic waters and the establishment of a 200 mile exclusive economic zone, in implementation of the UN Convention on the Law of the Sea. The Act charges the Minister responsible for fisheries with responsibility for the proper conservation and management of living resources and for ensuring theat those resources aare not endangered by over-exploitation. Within this context, it provides for the determination of the allowable catch in respect of each fishery in the EEZ, the determination of the proportion to be harvested by citizens of Trinidad and Tobago. This Act defines the archipelagic waters and the basis for delimiting the EEZ. Access of foreign fishing vessels to the archipelagic waters, territorial sea or EEZ is based on an allowable catch allocated to such vessels from the total allowable catch for the fishery. Foreign fishing licences can be issued by the Minister responsible for fisheries who also provides the authority for surveillance and enforcement of regulations pertaining foreign fishing.

***Legislation specific to Demersal Shrimp Trawling***

Under Section 4 of the *Fisheries Act*, the *Fisheries [Control of Demersal (Bottom) Trawling Activities] Regulations 1996,* specifies restrictions on the areas of operation of the different trawler fleets. Trawling is prohibited on the east coast of Trinidad and within 12 nautical miles of the coast of Tobago. Trawling is permitted on the north and south coasts of Trinidad outside of two nautical miles, and in the Gulf of Paria subject to a depth zoning regime based on the operational capacity of the trawl fleets anc an attempt to reduce conflict between the trawl fleets and other artisanal vessels. The regulations also prescribe a minimum stretched mesh size for the cod end of the trawl nets of 7.5 cm when trawling for fish, and 3.5 cm for shrimp.

The *Fisheries [Control of Demersal (Bottom) Trawling Activities] (Amendment) Regulations 1998*, specifies the amended zoning regime for the trawl fleets in the Gulf of Paria which requires artisanal trawlers to operate outside of one nautical mile from the coast, semi-industrial trawlers to depths of six fathoms or more and the industrial trawlers, to depths of 10 fathoms or more. As a result of conflicts arising between the industrial trawl fleet and artisanal and recreational fishermen on the north coast, the 1998 amendment further restricts trawling on the north coast to a specific area on the north-west of the coast and to a season from November and January. Trawling in this area is also prohibited at night.

The *Fisheries Act of 1916* does not provide a legal basis for controlling access by nationals of Trinidad and Tobago to fisheries resources under the national jurisdiction, and recognition of the need to limit fishing effort in the trawl fishery has been effected through a 1998 decision of the Cabinet to restrict entry of new vessels, both artisanal and industrial to the fishery. This measure is effective to a greater extent for the semi-industrial and industrial fleet where permission for the importation of any new fishing vessel must be obtained from the Minister with responsibility for fisheries.

Under the *Fisheries (Conservation of Marine Turtles) Regulations, 1994,* the semi-industrial and industrial fleets are required to use Turtle Excluder Devices (TEDs) on their nets. These regulations fall under Section 4 of the *Fisheries Act* and were drafted in accordance with trade requirements for the export of shrimp to the United States and the stipulations under Section 609 of United States Public Law 101 – 162.

The *Fishing Industry (Assistance) Act, 1955*, makes provisions for the granting of financial assistance to the fishing industry by such means as fuel rebates, tax waivers and subsidies on fishing equipment.

In recognition of the inadequacies in the existing legisation, a Fisheries Management Bill prepared in 1995, to be known on finalisation as the *Marine Fisheries Management Act*, will repeal the *Fisheries Act of 1916* and the sections of the *Archipelagic Waters and Exclusive Economic Zone Act of 1986*. The *Marine Fisheries Management Act* will provide for the preparation of fishery management plans, and will in accordance with these plans, control and limit access to fish resources through the establishment of a licensing system for both local and foreign fishing vessels.

## 4. RESEARCH ACTIVITIES (Past & present)

The resources of the Guyana-Brazil Shelf shrimp fishery are thought to belong to one stock. Recruitment and population dynamics of the local shrimp trawl fishery are therefore influenced by the activities within neighbouring trawl fisheries. Within the framework of the Western Central Atlantic Fisheries Commission (WECAFC) Working Group on the Shrimp and Groundfish Resources of the Brazil - Guianas Shelf a series of sub-regional workshops from 1992 to present have supported collaboration on the assessment of shared stocks of shrimp and groundfish.

Within this Working Group, Trinidad and Venezuela have collaborated on assessments of the shrimp resources from the Orinoco Delta - Gulf of Paria. Results indicate that there has been an overall decrease of CPUE with time and both biomass and recruitment showed evidence of an overall decline during the study period. A correlation between recruitment levels and environmental influences of the Orinoco River was noted.

Assessments of two sciaenid species in the fisheries off the west coast of Trinidad also indicated overfishing through intensive exploitation of these resources by several gear types including trawling.

National management initiatives include the development and strengthening of national monitoring capabilities through the introduction of logbook and observer programs for the offshore fisheries and the implementation of a detailed bio-economic analysis of the main components of the trawl fishery.

The current Trinidad and Tobago/Venezuela Fishing Agreement outlines a collaborative approach to the management of shared resources. This Protocol has not however been activated on a bilateral basis.

## 5. IMPACT ON THE SHRIMP RESOURCES OF PRESENT EXPLOITATION PATTERN

A preliminary stock assessment of the shrimp resources exploited by the artisanal trawl fleet that formerly operated in Venezuelan waters (Lum Young et al. 1992) showed that fishing effort was possibly excessive unless the annual recruitment is particularly high. The results indicated that increased fishing effort in the Orinoco Delta, although it may produce increased yields, may not generate enough revenues to offset the increased fishing costs. In addition, increased fishing effort may result in reduced migration of shrimp offshore into the Columbus Channel and thus reduced yields to the industrial trawl fishery operating in the Channel. A preliminary costs and earnings study for this fishery for the 1991/1992 fishing season (Ferreira and Maharaj 1993) found it to be marginally profitable at best, operating at little better than breakeven point and at a loss in years when recruitment is particularly low.

A joint Trinidad and Tobago/Venezuela assessment of the *P. subtilis* stock in the Orinoco Delta of Venezuela, Gulf of Paria and Columbus Channel was conducted by Alio et al. (1997). Combined catch and effort data for the trawl fleets of both countries for the period 1973 to 1996 were fitted to equilibrium and dynamic production models using the BIODYN software (Punt and Hilborn, 1996), as well as equilibrium models incorporating environmental variables using the CLIMPROD software (Freon, Mullon and Pichon 1993). This assessment suggests that overfishing during the period 1990 to 1993 (in the region of 15,500 to 19,500 days at sea) reduced the biomass level to below that required to produce the MSY of 1,200 to 1,300 tonnes resulting in lower catches over the period 1994 to 1996 of about 500 to 900 tonnes. It was recommended that fishing effort remain at or below the 1996 level (9,000 days at sea) for a few years to allow the stock to rebuild. These results are considered to be preliminary due to the fact that there are gaps in the data in particular for the industrial fleet in the case of Trinidad.

A costs and earnings study of the Type II artisanal, semi-industrial, and industrial fleets conducted by Ferreira (1998) found that, of the vessels surveyed, 33% of the artisanal, 50% of the semi-industrial, and 60% of the industrial were operating at a loss. The results of this analysis suggest that the artisanal boats are more efficient than the industrial ones, with the revenue per cost ratio, the benefit to crew and owner per unit of revenue, as well as the returns on investment being higher the smaller the trawler. In addition, the smaller trawlers are more labour intensive than capital intensive as compared to the larger trawlers, with the mean labour costs to current value of vessel being 0.7 for the artisanal, 0.2 for the semi-industrial, and 0.1 for the industrial.

A preliminary bio-economic analysis of the Trinidad and Tobago/Venezuela trawl fishery was conducted by Seijo *et al.* (1999). The model covers a four-year period and incorporates four of the shrimp species exploited in the Gulf of Paria-Columbus Channel region: *P. subtilis*; *P. schmitti*; *P. notialis*; and *X. kroyeri*. The study recommends that the fishing effort of both the Trinidad and Venezuelan fleets not be increased beyond the current level (8,175 days in industrial fleet units for Trinidad, and 9,348 days for Venezuela). Maximum profits to this shared fishery could be attained by reducing the effort of each of the Trinidad and Venezuelan fleets by approximately 3,000 days. (The input parameters to the model need to be refined and hence the results must be considered to be very preliminary).

## 6. IMPACT ON FISH RESOURCES OF THE PRESENT SHRIMP EXPLOITATION PATTERN

Demersal resources were investigated under a demersal trawl survey programme conducted by R/V Dr. Fridtjof Nansen in 1988 (Institute of Marine Research, Bergen, 1989). Additional data on groundfish species have been derived from several discrete surveys conducted over the past twenty years (Manickchand-Dass 1980; Amos 1990; Maharaj 1989; Fisheries Division 1986-unpublished).

A yield-per-recruit (Y/R) analysis for the whitemouth croaker, *Micropogonias furnieri* based on samples obtained by trawling in Trinidad waters between October 1977 and September 1982 (Manickchand-Heileman and Kenny, 1990) indicated that the maximum sustainable Y/R (175g) was already being obtained, and any increase in fishing mortality would result in overexploitation.

A further assessment of *Micropogonias furnieri* and *Cynoscion jamaicensis* (Jamaica weakfish) was performed using monthly catch and effort data for the period 1989 to 1997(Soomai et al 1999) from the artisanal and semi-industrial trawl fishery as well as the artisanal fishery comprising five gear types. Fishing mortality values were well above the optimum biological condition of the species and indicate that the resources are not generating optimum yield and most likely experiencing severe spawning potential decreases. The results of this assessment clearly indicate a very intensive exploitation of these resources.

A joint assessment by Trinidad-Tobago and Venezuela (Alio et al 1999) for *M. furnieri* in the Gulf of Paria and Columbus Channel using a surplus production biodynamic model suggests that the Maximum Sustainable Yield (MSY) of the species in the region is approximately 1500t. The MSY was exceeded between 1987 and 1993 and in 1998 when 1800t were landed. It was recommended that effort should not be allowed to increase beyond current levels of exploitation and that the open access fishery be replaced by a limited effort regime.

A bio-economic analysis performed for *M. furnieri* and *C. jamaicensis* was used to test several scenarios over a fifty(50) year simulation. Yield, net revenues and biomass were observed for the species in an "Open Access Fishery", a "Limited Entry Fishery" fixed at the existing level for each fleet, and at conditions of "Optimum Fishing Effort" fixed at half of the present level of effort. The probability of exceeding the 0.3% of the present value of rent and of exceeding 0.3% of the initial biomass (BI) for both species increases with an increase in effort (Seijo et al 1999). The suggested management strategy is to move towards a Limited Entry Fishery with an optimum fishing effort estimated at half of the present level.

## 7. IMPACT ON NON-FISH BY-CATCH OF PRESENT FISHING PRACTICES

There is limited information on the non-fish bycatch of the trawl fishery. Populations of portunid crabs which form a significant component of this category are thought to have increased as a result of the discards from the trawl fishery, which are thought to be beneficial to scavenger species. This observation is based on normal fishing practices where much of the bycatch of crabs is returned to the sea alive. In addition, anecdotal accounts from interviews with the fishing industry have described this change in the fauna of the Gulf of Paria. There may also be incidents of turtle capture by the fishery but the areas commonly trawled do not appear to be important routes for turtle migration and records do not indicate a high incidence of turtle capture in the areas where trawling is permitted.

## 8. IMPACT ON THE BOTTOM HABITAT OF PRESENT FISHING PRACTICES

There have not been any studies to determine the impact of trawling on the benthos in national waters. Initial analysis suggests that the trawl grounds are swept twice per year by the fleets although this is probably an underestimate for the inshore areas to which the artisanal vessels are restricted.

## 9. PERCEPTION OF THE PRESENT SITUATION REGARDING SHRIMP EXPLOITATION, INCLUDING ENVIRONMENTAL IMPACTS

### 9.1. The Shrimp fishing industry

A survey of key individuals in the trawl fishery was carried out in November 1999, in the preparatory phase of Project EP/INT/724/GEF, to examine the perceptions of individuals involved in the shrimp industry of the issues related to shrimp exploitation and the impacts of this fishery on the resources and environment. A questionnaire was developed to evaluate the position of trawler owners and operators on these issues. Key fishermen operating at the major trawl landing sites on the west coast were selected to be interviewed based on their willingness to co-operate with the Fisheries Division in the past. These individuals were either trawler owners who employed a fisherman to operate their vessels, active fishermen, or fishermen operating their own vessels. Eight (8) individuals representing the views of the artisanal, semi-industrial and industrial trawlers operating in the Gulf of Paria were interviewed.

All fishermen interviewed were generally of the view that pollution of the inshore area, due to industrial and agricultural run-off marine, has resulted in a significant decrease in fish populations. Many fishermen were also of the view that trawling for shrimp in inshore areas, which is prohibited under national legislation, is responsible for a further decrease in resources due to the removal, of large amounts of juvenile fish as by-catch, and physical damage to fishing grounds. Artisanal fishermen however, claimed that the operation of trawl nets, especially the industrial trawl nets, do more damage to fishing grounds than any other fishing gear. It was also the view of all fishermen that shrimp populations fluctuate seasonally but the fishery has remained profitable over the years.

It is the view of most fishermen that immediate management of shrimp and fish stocks resources is necessary. Management recommendations include an increase in current mesh size of trawl nets by ¼ inch will reduce by-catch while still maintaining the efficiency of catching shrimp. The view was also commonly held that shrimp and fish resources can be managed by the implementation of a closed season for trawling as well as limiting fishing effort by monitoring entry of new trawlers into the fishery. There was however a minority view that fishing effort should not be managed since the demersal trawl fishery is capable of regulating itself as vessels will enter or exit the fishery based on the economic returns to the fisherman.

Industrial trawler owners stated that large quantities of by-catch were inevitable due to the ecology of the area. The by-catch that is retained also includes small sizes of fish or juveniles which arelanded as "mixed fish" and the discards are comprised mainly of species with little or no commercial importance. At present, only small quantities of fish are discarded since there is a market in rural areas for the "mixed fish". Some of the fish which would have been discarded at sea by the industrial trawlers are used for making chicken feed.

All individuals interviewed could not perceive of any alternative fishing gear/method for catching shrimp but are willing to assist with testing of gear modifications or alternative gears if they are to continue operating in the trawl fishery. Some industrial trawler owners claim that they will support a government buy-out of trawlers. It is the common view of all trawl fishermen that there is an urgent need for government to enforce the regulations governing area/zone restrictions particularly with regards to artisanal vessels. This will ensure that juveniles are protected and will greatly reduce by-catch. Artisanal fishermen also believe that educating younger fishermen in resource management and increasing awareness on the impacts of fishing and land-based activities on the marine environment will contribute to management of the marine resources.

## 9.2 Other fishermen

Sources of information include a 'local knowledge survey' of 100 fishermen operating out of sites on the west coast of Trinidad, carried out by the Fisheries Division in 1994 (Ramjohn, 1995). The survey was developed in order to document the views, perceptions and attitudes of the fishing industry on resource management issues in the coastal area. The West Coast of Trinidad and the Gulf of Paria were studied because of the importance of the coastal area as a fishing ground and as a site for industrial activity, agriculture and shipping. The interviews were carried out using a questionnaire developed for the survey on a sample of 5% of the estimated population of fishermen, stratified by fishing method based on a 1991 census.

The results of the 1994 local knowledge survey indicated that the fishermen interviewed, perceived the greatest threat to the Gulf of Paria to be the trawling activity occurring there. All respondents noted a decline in individual catches and the majority thought that damage to the seafloor and destruction of juvenile fish by trawling was mainly responsible. Trawl respondents indicated that the major cause was pollution however 39% felt that trawling was responsible, with artisanal trawlers holding industrial trawlers responsible and industrial trawlers claiming that the inshore activities of artisanal trawlers was responsible.

The fishermen interviewed were generally of the view that the Government should introduce controls in the form of zonation, restricted areas and times of operation, and open/closed seasons for this particular fishing method in the Gulf of Paria. It was also noted that fishermen employing other methods considered trawling to be separate from other types of fishing and this perception affected their response to questions on the possible effects of over-fishing in the Gulf of Paria. It was not perceived that there could be over-fishing by other fishing methods.

A survey of key individuals in the trawl fishery was carried out in November 1999 in the Preparatory phase of Project EP/INT/724/GEF, to examine in greater detail the perceptions of the shrimp fishing industry to the issues related to shrimp exploitation and the impacts of this fishery on the resource and environment.

## 9.3 Environmental organizations

Environmental non-governmental organisations have a generally unfavorable perception of the impact of this fishery on both the habitat and the resources. There have been increasing efforts to lobby the Government to reduce the fishing areas accessible to the fleets and this has resulted in the closure of the North Coast fishing ground to the industrial fleet except for a season between November to January in a much reduced area off the western North Coast. Trawling in this area is also prohibited at night to reduce the possible of illegal fishing activity.

There have in addition been initiatives by groups operating out of coastal communities to place 'artificial reefs' in inshore areas in order to prevent the activity of trawlers in these areas.

## 9.4 The Authorities (Fishery & environment)

The Policy directions for this fishery are influenced by the Governments' recognition that the trawl fishery cannot be managed only for the shrimp resources harvested but must also be managed for the impact of this fishery on other inshore species taken as by-catch. Management policies must therefore consider the impact on other finfish resources and the fisheries which they support.

The Government recognises that a major factor contributing to over-fishing and over-capitalisation is the present "Open Access" regime which allows unregulated fishing effort in the fisheries. The Government in association with the fishing industry will attempt to manage fishing effort on the resources by controlling the number and type of local vessels within a given limit, and by implementing time and area closures, and fishing gear changes. The Government will also, through negotiation with neighboring countries, aim to reduce levels of fishing effort on shared fishing grounds.

The high proportion of finfish by-catch and its negative impact on the coastal ecosystem, as well as on the resources harvested by other fisheries, also influences policy decisions on this fishery. The Government therefore favours methods which minimise the amount of by-catch taken, and will

accordingly, monitor international developments and undertake local studies to investigate the most effective approach, including the use of alternative gear and the introduction of by-catch reduction devices.

## 10. KNOWLEDGE ABOUT NEW ENVIRONMENTALLY FRIENDLY TECHNIQUES & PRACTICES BY THE SHRIMP FISHING INDUSTRY

There is little knowledge within the fishing industry of gear or fishing practices that are environmentally friendly alternatives for harvesting shrimp on a commercial scale. In some cases where the use of hand operated nets have been proposed this is proposed as an alternative to artisanal trawling in shallow inshore waters.

## 11. PERCEPTION BY THE SHRIMP FISHING INDUSTRY TO MODIFY THEIR FISHING PRACTICES TOWARDS MORE ENVIRONMENTALLY FRIENDLY TECHNIQUES & PRACTICES

Interest has been expressed in technology for reducing by in the fishery by artisanal fishermen predominantly. The imposition of Turtle Excluder Devices (TED's) on the semi-industrial and industrial trawl fleets has been not been well accepted by the industry. The requirement to use these devices has been particularly unpopular with the semi-industrial fleet for which the U.S. export market is of less importance. This fleet claims that the device traps large debris in the net, causing damage to the net or significant loss of catch as shrimp are diverted away from the cod end.

Given the existence of regulations for the use of TED's within the national legislation, the industry cannot perceive how further modification of the trawl gear to reduce finfish by-catch will not affect the overall operation of the gear in the capture of shrimp and the economically important component of the by-catch.

## 12. AN ANALYSIS OF THE SOCIAL IMPLICATIONS OF ADJUSTING FISHING TO MORE ENVIRONMENTALLY FRIENDLY PRACTICES

| Management Action | Impact on Trawl Owners/ Operators | Impact on the Fishing Industry | Impact on the Wider Community |
|---|---|---|---|
| Closed Areas | Increased fishing effort on existing non-protected fishing grounds, reduced CPUE, lower profits (immediate effects) | Increased conflict with other fleets (and gear types) operating on the same grounds | Requirement for enhanced conflict resolution capability |
| Closed Seasons | Alternative fishing methods and target species, or other forms of employment must be identified, for closed time period. Higher CPUE and higher profits in fishing season | Reduced conflict with other fishing methods unless vessels divert to another fishery in the closed area. Marketing opportunities become seasonal, increased catches, for other fishing fleets | Unavailability of cheaper sources of fish in rural communities, increased competition for employment |
| Reduced Fleet Size | Possible overcapitalisation of other fisheries, unemployment for crew, higher catches and profits for remaining vessels. | Reduced conflict with trawl fishery, | |
| Bycatch reduction modification to trawl gear | Reduced fish catches and loss of earnings, reduced conflict with other fisheries and the wider community. Increased finfish catches (long-term) and related marketing opportunities | Improved catches of groundfish (long-term), reduced conflict with trawl fishery | Unavailability of cheaper sources of fish in rural communities |

| Management Action | Impact on Trawl Owners/ Operators | Impact on the Fishing Industry | Impact on the Wider Community |
|---|---|---|---|
| Alternative gear | May require fishing patterns modification to avoid conflicts. Training in new gear technology required. | | |

## 13. NATIONAL IDENTIFICATION OF PRIORITY ISSUES REQUIRING ACTIONS TO MEET ACCEPTABLE STANDARDS OF ENVIRONMENTALLY FRIENDLY SHRIMP EXPLOITATION

1. Strengthening of fishing sector organisations

2. Building of awareness within the fishing industry ( including the preparation of trawl-related information as an aid to communication).

3. Co-operative introduction of by-catch reduction technology and testing of the gear through commercial-scale field trials.

4. Monitoring and reporting on fishing operations and gear trials through logbook and observer programmes, and effective monitoring, control and surveillance.

## 14. PROPOSAL FOR A PLAN OF ACTION FOR DEVELOPMENT OF ENVIRONMENTALLY FRIENDLY TECHNIQUES AND PRACTICES FOR SHRIMP EXPLOITATION AT NATIONAL, REGIONAL AND GLOBAL LEVEL

### A) Information Review (background to main phase)

- Impact of trawling (Habitat and Ecosystem)
- Alternative shrimp capture methods (gear, operations, costs)
- Fishing regimes including bio/socio/economic scenario analyses (fishing effort allocation between fleets)
- Community review (dependency, contribution, aspirations, economic opportunities)

### B) National Capacity Development

I) Develop a cooperative approach to Fisheries Management (structure, operations, support )

II) Fishing Community Development

- Strengthening of fishing sector organisations
- Re-training and alternative employment (identification and facilitation)
- Multi-stakeholder collaboration (with civic and commercial organisations)

III) Governmental Capacity Development

- Management Program Review ( Staff, funding, Program)
- Staff training (extension, management, regulatory, assessment)
- Information systems development (Catch and Effort, logbooks, biological, fisherman and fishing vessel)
- Monitoring, Control and Surveillance including orientation for Coast Guard, Police, Magistracy
- Legislation – Updating and harmonisation

### C) Bilateral & Sub-regional Harmonisation

I) Reduction in Fishing Capacity and Harmonisation of Management Regimes

**D) Commercial – Scale Field Trials**

I) By-catch documentation (Area/ Time/ Gear)

II) Gear trials (BRD, alternative gear)

**E) Management Plan Development**

**Appendix I**

**Most common species in trawl catches of Type II & III vessels.**

| Family | Common Name | Genus and Species |
|---|---|---|
| Albulidae | Bonefish | Albula vulpes |
| Ariidae | Catfish | *Arius parkerii* |
| | | *Arius felis* |
| Batrachoididae | Toadfish | *Batrachoides surinamensis* |
| Bothidae | Dusky flounder | *Syacium papillosum* |
| Calappidae | Flecked box crab | *Hepatus pudibundus* |
| Carangidae | Atlantic bumber | *Chloroscombrus crysurus* |
| | Cavalli | *Caranx hippos* |
| | Moonshine | *Selene vomer* |
| Centropomidae | Snook, brochet | *Centropomus undecimalis* |
| | Snook, brochet | *Centropomus ensiferus* |
| Clupeidae | Herring | *Hanengula sp.* |
| | Spanish sardine | *Sardinella aurita* |
| | Atlantic thread herring | *Opisthonema oglinum* |
| Cynoglossidae | Duskycheek tonguefish | *Symphurus plagusia* |
| Dasyatidae | Stingray | *Dasyatis americana* |
| Engraulidae | Anchovy | *Anchoa sp* |
| | Anchovy | *Lycengraulis grossidens* |
| | Anchovy | *Cetengraulis endentulus* |
| Ephippidae | Spadefish | *Chaetodipterus faber* |
| Gerreidae | Blinch | *Diapterus rhombeus* |
| | Blinch | *Eucinostomus havana* |
| Haemulidae | Grunt | *Anistoremus virginicus* |
| | Grunt | *Genyatremus luteus* |
| | Black grunt | *Haemulodon bonariense* |
| Loliginidae | Squid | *Lolliguncula brevis* |
| | Squid | *Loligo pealei* |
| Lutjanidae | Lane snapper | *Lutjanus synagris* |
| Mugilidae | Mullet | *Mugil curema* |
| Penaeidae | White shrimp | *Penaeus schmitti* |
| | Pink shrimp | *P. notialis* |
| | Brown shrimp | *P. subtilis* |
| | Seabob, honey shrimp | *Xiphopenaeus kroyerii* |
| Polynemidae | Barbe | *Polydactylus virginicus* |
| Portunidae | Swimcrab | *Callinectes sp* |
| Scaeinidae | Jamaica weakfish, salmon | *Cynoscion jamaicensis* |
| | Acoupa weakfish, salmon | *Cynoscion acoupa* |
| | Smalltooth weakfish, salmon | *Cynoscion steindachneri* |
| | Whitemouth croaker, cro-cro | *Micropogonias furnieri* |
| | King weakfish, salmon | *Macrodon ancylodon* |
| | King croaker | *Menticirrhus americanus* |
| Serranidae | Sea bass | *Diplectum radiale* |
| Soleidae | Sole | *Achirus achirus* |
| | Sole | *Trinectes paulistanus* |
| Sphyraenidae | Bechine | Sphyraena guachancho |
| Tetraodontidae | Puffer fish | *Sphoeroides testudineus* |
| Trichiuridae | Cutlass fish | *Trichiurus lepturus* |
| Triglidae | Sea robin | *Prionotus punctatus* |

## BIBLIOGRAPHY

Alio, J., D. Die, L. Ferreira, S. Kuruvilla, L. Maharaj, and L. Marcano. 1997. *Penaeus subtilis* stock within the Orinoco and Gulf of Paria region. Working Group Report. CFRAMP/FAO/DANIDA Stock Assessment Workshop on the Shrimp and Groundfish Resources of the Guianas-Brazil Shelf, April 7-18, Port of Spain, Trinidad and Tobago.

Alio, J., L. Marcano, S. Soomai, T. Phillips, D. Altuve, D. Die, and K. Cochrane. 1999. Analysis of industrial trawl and artisanal fisheries of whitemouth croaker, Micropogonias furnieri, of Venezuela and Trinidad-Tobago in the Gulf of Paria and Orinoco River Delta. Third CFRAMP/FAO Workshop on Stock Assessment of Shrimp and Groundfish Fisheries of the Brazil-Guiana Shelf, Belem, Brazil, 25 May- 9 June 1999 (in press).

Amos, M. (1990). A study of Type III shrimp trawling in the Gulf of Paria. Project Report: Centre for Resource Management and Environment Studies, The University of The West Indies, Cave Hill Campus, Barbados. Advanced Diploma. 56 p.

Chan A Shing, C. 1999. Report on 1998 census of fishing vessels (Trinidad). Fisheries Internal Report No. 3. Port of Spain, Trinidad: Ministry of Agriculture, Land and Marine Resources.

Chin Yuen Kee, Z. 1984. The shrimp fisheries of Trinidad and Tobago. Project Report: University of Rhode Island, Kingston, Rhode Island. 30 p.

Cropper, ., D. Carrington, G. Goddard, G. Ramjag, and S. Solomon. 1997. The impact of the loss of fishing rights in Venezuelan waters on three villages in SW Trinidad. St. Augustine, Trinidad: Sustainable Economic Development Unit (SEDU), Department of Economics, University of the West Indies (UWI).

Dragovich, A., A.C. Jones, and G.C. Boucher. 1980. United States shrimp surveys off the Guyana and Northern Brazil (1972-1976). In Jones, A.C. and L. Villegas, (eds.), Proceedings of the Working Group on shrimp fisheries of northeastern South America. WECAFC Rep. 28, pp. 1-46.

FAO classification of major fishing areas for statistical purposes. FAO Fisheries Circular No.420. Rome: FAO.

Ferreira, L.A. 1998. Economic analysis of the shrimp trawl fishery of Trinidad and Tobago with management implications. Master of Marine Management Graduate Project, Dalhousie University, Halifax, Nova Scotia.

Ferreira, L. and L. Maharaj. 1993. Preliminary costs and earnings study of the artisanal shrimp trawlers operating in the "Special Fishing Area" adjacent to the mouth of the Orinoco river (Venezuela). Technical report of the project for the Establishment of Data Collection Systems and Assessment of the Fisheries Resources. FAO/UNDP: TRI/91/001/TR14. Port of Spain, Trinidad: Ministry of Agriculture, Land and Marine Resources.

Fisheries Division and Food and Agriculture Organisation of the United Nations. 1992. Draft management plan for the shrimp trawl fishery of Trinidad and Tobago. Management report of the project for the Establishment of Data Collection Systems and Assessment of the Fisheries Resources FAO/UNDP: TRI/91/001/TR26. Port of Spain, Trinidad: Ministry of Agriculture, Land and Marine Resources.

Freon, P.; Mullon, C.; Pichon, G. (1992). CLIMPROD: experimental interactive software for choosing and fitting surplus production models including environmental variables. FAO; Rome (Italy). FAO Comput. Info. Ser. (Fisheries). no. 5, 82 p. 1992.

Garcia, S. and L. Le Reste. 1981. Life cycles, dynamics, exploitation and management of coastal penaeid shrimp stocks. FAO Fish. Tech. Pap. (203). 215 p.

Gines, H.; Angell, C.L.; Arocha, M.M.; Rodriguez, G.B.D.; Febres, G.A.; Gomez, R.; Rubio, J.; Pastor, G.; Otalola, J.R. (1972). Carta pesquera de Venezuela. 1. Areas del nororiente y Guayana. [Venezuelan fishery chart. 1. Northeastern areas and Guyana.] Corporacion Venezolano Fom.; (Venezuela). Monogr. Fund. La Salle Cienc. Nat. Venez. no. 16, 328 p. 1972.

Institute of Marine Research, Bergen. (1989). Surveys of the fish resources in the shelf areas between Suriname and Columbia, 1988. Institute of Marine Research, Bergen, Norway. 139 p.

Jordan, C.M. (1969). A survey of the shrimp industry of Trinidad and Tobago. Ministry of Agriculture, Lands and Food Production; Port of Spain (Trinidad and Tobago). 8 p. 1969. Mimeo.

Lum Young, P., L. Ferreira and L. Maharaj. 1992. Preliminary stock assessment for the shallow water shrimp trawl fishery in the "Special Fishing Area" adjacent to the mouth of the Orinoco River (Venezuela). Technical report of the project for the Establishment of Data Collection Systems and Assessment of the Fisheries Resources. FAO/UNDP: TRI/91/001/TR9. Port of Spain, Trinidad: Ministry of Agriculture, Land and Marine Resources.

Maharaj, L., L. Ferreira and P. Lum Young. (1993). Description of the shrimp trawl fishery of Trinidad. Technical Report of the Project for the Establishment of Data Collection Systems and Assessment of the Fisheries Resources. FAO/UNDP: TRI/91/001/TR5. Port of Spain (Trinidad). 16 p.

Maharaj, V. (1989). The by-catch in the artisanal shrimp trawl fishery, Gulf of Paria, Trinidad. M.S. Thesis:University of Rhode Island, U.S.A. 168 p.

Manickchand-Dass, S. (1980). Studies of the Biology of the croaker, Micropogonias furnieri (Desmarest, 1823) in Trinidad, West Indies. M.Phil Thesis: University of the West Indies, St Agustine, Trinidad and Tobago. 138 p.

Manickchand-Heileman, S.C. and J.S. Kenny (1990). Reproduction, Age, and Growth of the Whitemouth Croaker, Micropogonias furnieri (Desmarest 1823) in Trinidad Waters. Fish. Bull. vol. 88, No. 3., p. 523-529.

Meyers, L. (1997). Privatisation of the National Fisheries Company of Trinidad and Tobago - case study. Report of the workshop on the role of financial institutions in strengthening national fisheries industries and privatization of fisheries investment in small island developing states. Port of Spain, Trinidad and Tobago, 24-28 June 1996.

FAO; Rome (Italy). FAO Fish. Rep. no. 549, p. 113-121. FITT/R549. 158 p. 1997.

Punt, A.E.; Hilborn, R. (1999). Biomass dynamic models. User's manual.

Ramjohn, D. (1995). Local knowledge survey, FAO/UNDP Project "Integrated Coastal Fisheries Management". FL.DP/INT/91/007. 52 p.

Seijo, J.C., J. Alio, L. Ferreira, and L. Marcano. 1999. Preliminary bio-economic analysis of the Trinidad & Tobago / Venezuela trawl fishery. Working Group Report. III Workshop on the Shrimp and Groundfish Fisheries on the Brazil-Guianas Shelf, May 26-June 10, 1999, Belem, Para, Brazil. Draft.

Soomai, S., Phillip, T., Ehrhardt, N., Cochrane, K. (1999). Stock Assessment of Two Sciaenid Fisheries in the West Coast of Trinidad and Tobago. Draft Working Group Report: Third CFRAMP/FAO/ Stock Assessment Workshop on the Shrimp and Groundfish Resources of the Guianas-Brazil Shelf, Belem, Brazil, 25 May- 9 June, 1999 (in press)

Wood, H.E. (1978). * Two case histories of successful fisheries development in Trinidad and Tobago. Higman, J.B.; Williams, F.; Roedel, P.M. (ed.) Conference on the development of small-scale fisheries in the Caribbean region. Cartagena, Colombia, November 16-17, 1977. University of Miami; Florida (USA). p. 153-162. Sep 1978. Development of Small-Scale Fisheries in the Caribbean Region. Cartagena (Colombia); 16 Nov 1977.

**VENEZUELA**

## REVISIÓN DE LA PESCA DE ARRASTRE EN VENEZUELA

Presentado en el Taller Regional; Costa Rica; 12-14 Enero, 2000

Por Luis A. Marcano (Coordinador nacional) y José J. Alió, Daniel Novoa R., Douglas Altuve, Glennys Andrade y Rodolfo Álvarez (FONAIAP; Av.Carupano - Caiguire Apdo. 236; Cumana, Sucre 6101-A; Venezuela; Fax: 58 93 317557)

## Abstract

In 1997, the trawlers landed 3 665 t of shrimp (brown shrimp (*Penaeus brasiliensis, P. subtilis* and *P. notialis*), white shrimp (*P. schmitti*) and "titi" (*Xyphopenaeus kroyeri*) and almost 23 000 t of fish and molluscs. Almost two thirds of the shrimp are landed in the west of the country.

In 1997 the fleet in operation consisted of 351 trawlers, almost all with outriggers. The minimum codend mesh size is 32 mm. All trawls are equipped with a Turtle Excluder Device.

The ratio shrimp to total catch varies from 1:17 to 1:40. One third of the by-catch is normally landed, the remainder is discarded, essentially small fish (80% of which are juveniles from species with commercial interest).

Most shrimp are exported and the fish, including so called "by-catch" which is landed, is sold on the domestic market.

Research has been carried out for years regarding shrimp fisheries: to estimate the amount of by-catch, its composition and geographical distribution; to reduce the discards by installing escape panels in the trawl. After the introduction of TED, the impact of the device on the general catch was assessed: significant losses were found in the capture of fish, molluscs and shrimp. More recently, some research has been carried out on the utilization of unavoidable by-catch.

The main problems reported include, in particular: overexploitation of shrimp resources, particularly in coastal areas, capture of juvenile fish and conflict between trawlers and artisanal fishers.



## Resumen

En 1997, las embarcaciones de arrastre desembarcaron 3.665 toneladas métricas de camarón marrón (*Penaeus brasiliensis, P. subtilis* y *P. notialis*), camarón blanco (*P. schmitti*) y camarón tití (*Xyphopenaeus kroyeri*), y casi 23.000 toneladas métricas de pescado y moluscos. Alrededor de dos tercios de las capturas fueron descargadas al occidente del país.

En 1997 la flota operativa estaba constituida por 351 arrastreros, la mayoría con tangones. La abertura de malla mínima en el copo de la red es de 32 mm. Todas las embarcaciones de arrastre están equipadas con dispositivos exclusores de tortugas (TED).

La relación entre la captura de camarón y la captura total varía de 1:17 a 1:40. Normalmente se desembarca un tercio de la fauna de acompañamiento, el resto es descartado. La fauna descartada está constituida básicamente por pescados pequeños (de los cuales, el 80% son juveniles de especies de interés comercial). La mayor parte del camarón se exporta, mientras que el pescado, incluyendo las especies provenientes de la fauna de acompañamiento, se vende en el mercado local.

Durante años se ha llevado a cabo investigación en relación con la pesquería del camarón, a fin de estimar la cantidad de fauna de acompañamiento, su composición y distribución geográfica; para reducir los descartes mediante la instalación de paños de escape en los arrastreros. Luego de la introducción de los TED, se midió el impacto de estos dispositivos sobre las capturas generales encontrándose pérdidas significativas en las capturas de peces, moluscos y camarón. Más recientemente se han efectuado investigaciones sobre la utilización de la fauna de acompañamiento del camarón, cuya captura incidental resulta imposible de evitar.

Los principales problemas reportados incluyen: sobre-explotación de los recursos camaroneros, particularmente en las áreas costeras, captura de peces juveniles y conflictos entre las pesquerías de arrastre y artesanal.

## 1. INTRODUCCIÓN

Las costas marinas venezolanas tienen una extensión de 2.830 kilómetros y una plataforma continental de 90.000 kilómetros cuadrados. A partir de la creación del nuevo régimen jurídico del mar la jurisdicción nacional se amplió hasta 200 millas, lo que determina una extensa zona económica exclusiva de unos 640.000 kilómetros cuadrados. Esta situación representa para Venezuela una oportunidad sin precedentes de expandir y desarrollar la actividad pesquera, con aprovechamiento integral de los recursos marinos.

Venezuela, como país ribereño del Atlántico Centro Occidental, tiene una ubicación favorable desde el punto de vista pesquero, como consecuencia de la corriente ecuatorial del norte y de fenómenos de surgencia localizados a lo largo de sus costas, que inducen a una alta productividad en sus diversos ecosistemas y a la presencia de una variedad de especies de peces, crustáceos y moluscos. Estos constituyen soporte de importantes pesquerías y otras actividades conexas, como la acuicultura y la industria del procesamiento, que han llevado al país a ocupar una importante posición entre los productores latinoamericanos con una producción pesquera cercana a las 450.000 toneladas por año.

La pesca en Venezuela ha venido registrando un progresivo crecimiento y hoy día constituye un renglón de importancia en la economía agrícola nacional, siendo su aporte del 5%. El 50% de las divisas que ingresan al país por concepto de exportación agrícola corresponden al sector pesquero; lo cual se estima en más de 182 millones de dólares americanos.

Entre las pesquerías desarrolladas en el país, una de las más importantes es la pesca industrial de arrastre camaronero por las implicaciones de carácter económico y social, a pesar de ser una pesquería controversial por su impacto sobre el medio ambiente marino, en particular sobre la ictiofauna y otros organismos marinos.

En Venezuela, la pesca industrial de arrastre camaronera se realiza en forma extensiva a lo largo de toda la costa, mediante esta actividad se capturan una gran cantidad de especies de peces, moluscos y crustáceos de importancia comercial, los cuales se desembarcan en los distintos puertos pesqueros del país (Marcano, 1990; Giménez, 1993; Novoa, *et al.* 1998). Durante esta actividad también se capturan de manera incidental una gran cantidad de peces y otros organismos marinos (conocida como fauna de acompañamiento del camarón ó FAC), que luego son devueltos al mar por consideraciones de orden económico. Igualmente se capturan cierta cantidad de tortugas, para las cuales se han tomado ya las medidas pertinentes para evitar su captura (Marcano, 1998; Marcano, *et al.* 1998).

En el presente trabajo se describen características de las pesquerías de arrastre artesanales e industriales de Venezuela, considerando especialmente el componente de la fauna descartada.

## 2. ESTADO DE DESARROLLO DE LA INDUSTRIA DE LA PESCA DE ARRASTRE

### 2.1 Inicio de la pesca de arrastre

La pesca de arrastre comienza exploratoriamente en Venezuela a finales de la década de los cuarenta (1948) pero su desarrollo comercial se inicia a partir de la década de los cincuenta, con operaciones realizadas en el Golfo de Venezuela, mediante embarcaciones conocidas como tipo italiano o mediterráneo. Estas embarcaciones operaban desde Punto Fijo y Maracaibo, después de haber realizado pesca exploratoria a lo largo de la costa nacional para identificar las áreas de mayor abundancia de camarones, moluscos cefalópodos y peces (Giménez, *et al.* 1993). El uso de estas embarcaciones duró aproximadamente 10 años y a partir de 1963 se inicia un proceso de reemplazo de las embarcaciones tipo mediterráneo por las embarcaciones tipo florida o americano. La existencia de otras áreas de abundante recurso camaronero y peces de alto valor comercial, de fácil acceso y facilidades de servicios influyeron determinantemente para que esta pesquería se desarrollara en otras zonas del país. De esta manera la pesca de arrastre en la zona central, con base en Puerto Cabello y que desarrolla actividades en el área de Golfo Triste, se inicia en 1950, con dos embarcaciones (Salaya, *et al.* 1980). La pesca de arrastre en la región oriental, se inicia en 1960, desde el puerto base de Guanta (estado Anzoátegui), desarrollando actividades en la Plataforma de Unare. Posteriormente se incorporan más unidades de arrastre. Algunas de las embarcaciones se trasladan hacia Cumaná en 1967, tomando como puerto base a esta ciudad, para iniciar actividades en áreas de pesca situadas alrededor de la isla de Margarita. Finalmente, la pesca de arrastre en el Margen Atlántico de la

Guayana se inicia en 1968, con embarcaciones dotadas con permisos especiales, tomando como puerto base de operaciones a la ciudad de Güiria. (Novoa, *et al.* 1980; Marcano, *et al.* 1995).

## 2.2 Zonas de pesca

Desde el punto de vista pesquero y para efectos administrativos, las costas marítimas del país han sido divididas en tres zonas: occidental, central y oriental, tomando como base para la división los límites políticos de los estados costaneros (Fig. 1). En consecuencia, esta división no se basa en elementos de tipo ecológico o ambiental, aunque cada una de ellas presentan ciertas particularidades de carácter ecológico y ambientales (fondo, fauna, profundidad, surgencias, corrientes, pluviometría, salinidad, temperatura, etc.) que las diferencia notablemente entre sí.

**La zona occidental** se extiende desde Punta Castilletes en el estado Zulia, hasta Punta de Chichiriviche en el estado Falcón, contemplando las costas de estos dos estados, donde destaca el Golfo de Venezuela como principal área de pesca. Esta zona tiene un área aproximada de 15.300 kilómetros cuadrados (Racca & Griffiths, 1972). Actualmente el único puerto base en la zona es el de Punto Fijo. Su profundidad esta comprendida entre 5 y 120 brazas. Los fondos de esta zona son casi exclusivamente fangosos y fango-arenosos, encontrándose áreas de arena mezclada con arena fangosa (sur de la Península de la Guajira y sur de Paraguaná); fondo rocoso (suroeste de Castilletes y Archipiélago de los Monjes) y fondos arenosos (norte de la Guajira). Los recursos de la zona están representados en su mayoría por cinco familias y grupos de especies, dentro de los cuales destacan: Penaeidae (camarón blanco y camarón marrón), Sciaenidae (curvinas, curvinatas y roncador); Haemulidae (corocoros); Lutjanidae (pargos); Loliginidae (calamares); Octopodidae (pulpo); Sphyraenidae (picúas); Carangidae (chicharra, lamparosa); Priacanthidae (catalana) Sparidae (cachicatos); Monacanthidae (cachúas) (Ginés, *et al.* 1982; Anónimo, 1990; Novoa, *et al.* 1993).

**La zona Central** se extiende desde Chichiriviche hasta Cabo Codera, estado Miranda y comprende las costas de los estados Carabobo, Aragua y Miranda. La principal área de pesca la constituye Golfo Triste y áreas adyacentes. Tiene una superficie aproximada de 26.000 kilómetros cuadrados y su único puerto base es Puerto Cabello (Salaya, *et al.* 1980). Los fondos son predominantemente fangosos y areno-fangosos, exceptuando la estrecha plataforma continental de afloramiento rocoso. Los fondos arrastrables en la zona se ubican entre las 2 y 90 brazas de profundidad. Los recursos más importantes están representados por las siguientes familias: Lutjanidae (pargos, cunaros y panchito); Haemulidae (corocoros); Sciaenidae (curvinas, merluzas, curvinatas, roncador); Carangidae (cataco, lamparosa); Loliginidae (calamares); Octopodidae (pulpo); Carcharhinidae y Triakidae (tiburones y cazones); Penaeidae (camarones).

**La zona Oriental** se extiende desde Cabo Codera hasta el río Esequibo, comprendiendo las costas de los estados Miranda, Anzoátegui, Sucre, Nueva Esparta, Monagas y Delta Amacuro. La zona está comprendida por dos subzonas: la nororiental, que va desde Cabo Codera hasta Punta Paria (Caribe Oriental de Venezuela) y la que va desde Punta Paria hasta la desembocadura del río Esequibo (Margen Atlántico de Venezuela).

En la primera, existen dos grandes áreas de pesca: el área entre Cabo Codera y Morro de Barcelona y la que se ubica alrededor de la Isla de Margarita y Costa norte del estado Sucre. En la primera, los fondos arrastrables se ubican entre las isóbatas de 2 y 25 brazas de profundidad y están enmarcados en una estrecha franja que corre a lo largo de la costa. Sólo, al norte y al este de las Isletas de Píritu la plataforma es un poco más amplia y las 25 brazas se alcanzan dentro de una distancia de aproximadamente 10 millas de la costa. Los fondos de esta área son, en general, completamente fangosos hasta las 10 brazas de profundidad, fangoso-arenoso entre las 10-20 brazas y arenosos a profundidades mayores de 20 brazas (Novoa, *et al.*, 1980; Mendoza, *et al.* 1993a y b). Los recursos más abundantes en el área son los pertenecientes a la familia Penaeidae (camarones, camarón tití); Sciaenidae (roncador, tonquicha, curvinas); Ophidiidae (perla); Carangidae (lamparosa); Loliginidae (calamares), Octopodidae (pulpo); Centropomidae (robalo); Serranidae (meros, cunas); Gerridae (caitipa, mojarras); Sphyraenidae (picúas); Priachantidae (catalana); Trachuridae (tahali).

En las áreas alrededor de la Isla de Margarita y norte de Sucre, la pesca se realiza al norte y este de la Isla de Margarita y al norte del estado Sucre. Los fondos son predominantemente arenosos y alrededor de la Isla de Margarita los fondos contienen alto porcentaje de restos de conchas y de coral. Entre la Isla de Margarita y el Archipiélago de Los Testigos los fondos son relativamente someros, oscilando

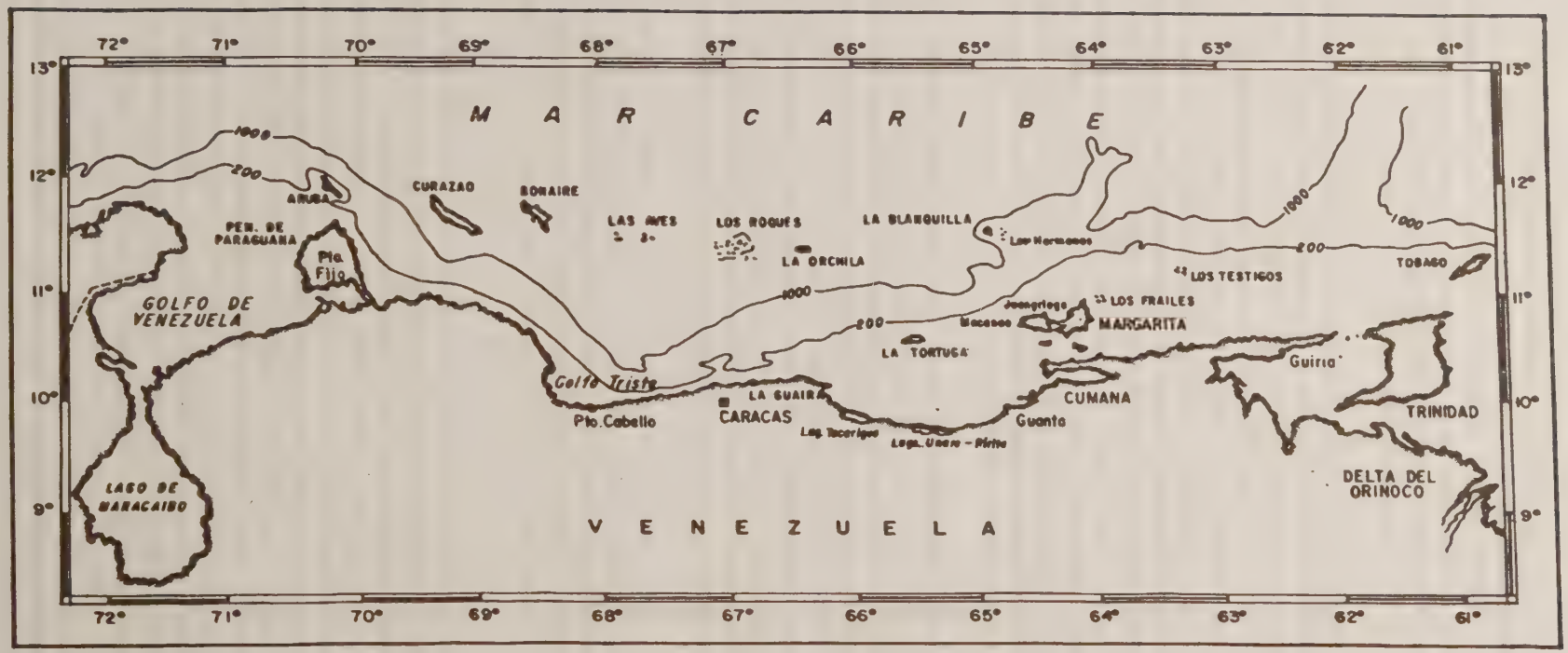



**Fig. 1 Mapa de las costas marinas de Venezuela**

entre 5 y 30 brazas, aproximadamente. Hacia el norte, las profundidades son mayores. La isóbata de las 20 brazas se encuentra dentro de las 10 millas en relación con la línea de costa. Después de esta isóbata se extiende una franja de 10 a 20 millas, en donde las profundidades oscilan entre 20 y 75 brazas. Frente a las costas al norte del estado Sucre se ha verificado la existencia de fondos duros y rocosos, alternando con fondos suaves. Los fondos más promisorios, en cuanto a recursos, son los ubicados frente a la ciudad de Carúpano y a ambos extremos de esta ciudad. Hacia el extremo oriental del estado Sucre, frente a la península de Paria, la plataforma continental es bastante estrecha, encontrándose profundidades superiores las 60 brazas (Novoa, et al. 1980). Los recursos más importantes del área son: Penaeidae (camarones); Octopodidae (pulpo); Loliginidae (calamares); Haemulidae (corocoros); Priacanthidae (catalana); Carangidae (cataco, lamparosa); Pectinidae (concha vieira); Sciaenidae (roncador, tonquicha); Lutjanidae (panchito, pargos); Triakidae (cazones); Dasyatidae (rayas); Bothidae (lenguados); Serranidae (meros, cunas, etc.).

***El Margen Atlántico de Venezuela***. Esta subzona se extiende desde Boca de Dragón, en el extremo oriental de la Península de Paria, hasta la desembocadura del río Esequibo en el sur, abarcando una superficie de 71.000 kilómetros cuadrados. Esta zona se encuentra beneficiada por la influencia de aguas ricas en materia orgánica procedentes de los ríos Amazonas, Esequibo, Orinoco, entre otros. Este material es transportado por la corriente de Guayana originando una zona de alta productividad. Dentro de esta subzona se distinguen dos áreas: el Golfo de Paria y el Margen Atlántico de la Guayana venezolana.

***El Golfo de Paria***. Es un cuerpo de agua que representa el último remanente marino de la cuenca Oriental del mar Caribe con una superficie de 9.700 kilómetros cuadrados, encerrada entre las costas de Venezuela (Península de Paria ) y la costa occidental de Trinidad. Queda bajo la influencia casi única de las aguas del río Orinoco. Sus aguas son turbias, de baja salinidad, y su profundidad es siempre menor de 30 metros, presentando un área amplia de profundidad muy baja (menos de 3 metros). Los fondos son generalmente fangoso y fango-arenoso. Recibe agua de los caños que se abren en él y de la Boca de Serpiente, y envía luego estas aguas al norte por la Boca de Dragón (Ginés, 1972).

***El Margen Atlántico de la Guayana.*** Esta zona tiene una extensión de aproximadamente 618 kilómetros de costa, que comprende desde Punta Bombeador (Caño Macareo) hasta la desembocadura del río Esequibo, con una superficie total de 600.000 kilómetros cuadrados. Recibe directamente las aguas del río Orinoco. Los fondos son fangosos en su totalidad. Frente al Orinoco, la plataforma y el talud del Delta frontal están cubiertos por una franja de fango hasta una distancia de 80 kilómetros de la costa. Los recursos pesqueros más importantes de esta subzona son: Penaeidae (camarones y camarón titi); Sciaenidae (curvinata, roncador, curvinas); Scombridae (carites); Carangidae (jurel, lamparosa, pámpanos); Lutjanidae (pargos); Serranidae (meros, cunas) (Anon, 1990; Marcano *et al.* 1994).

## 2.3 Flota

Actualmente, la mayoría de las unidades de arrastre que operan son del tipo Florida. Estas unidades hacen uso de dos redes simultáneamente, una por cada costado. De las 351 embarcaciones de arrastre permisadas que operan en el país, 8 son del tipo ramperas. Estas embarcaciones operan las redes por la popa y se dedican exclusivamente a la captura de peces. Esta flota presenta una gran variabilidad y heterogeneidad en cuanto a las características estructurales y el poder de pesca. La flota arrastrera nacional se encuentra distribuida de la siguiente manera: 159 en la zona occidental, 5 en la zona central y 187 en la zona Oriental.

En los últimos diez (10) años no se han incorporado nuevos avances tecnológicos en la flota arrastrera nacional. A pesar de la incorporación, en los últimos cinco años, de embarcaciones ramperas de gran tamaño y elevado poder de pesca, acondicionadas para pescar en aguas profundas, la flota arrastrera tradicional no ha incorporado nuevas tecnologías de captura (Marcano, 1990).

**TABLA 1. Número de embarcaciones de la flota de arrastre de Venezuela, por puerto base durante el período 1985-97**

| PUERTO BASE | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cumaná | 64 | 78 | 70 | 95 | 125 | 123 | 124 | 108 | 101 | 93 | 96 | 94 | 92 |
| Guiria | 34 | 20 | 34 | 36 | 35 | 50 | 58 | 69 | 68 | 55 | 51 | 49 | 49 |
| Guanta | 25 | 28 | 33 | 39 | 51 | 51 | 50 | 47 | 47 | 47 | 50 | 44 | 46 |
| **Total Reión oriental** | **123** | **126** | **137** | **170** | **211** | **224** | **232** | **224** | **216** | **195** | **197** | **187** | **187** |
| Carabobo | 5 | 4 | 4 | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| **Total Región central** | **5** | **4** | **4** | **3** | **3** | **3** | **5** | **5** | **5** | **5** | **5** | **5** | **5** |
| Falcón | 144 | 153 | 176 | 166 | 219 | 219 | 212 | 186 | 184 | 173 | 171 | 153 | 159 |
| **Total Región occidental** | **144** | **153** | **176** | **166** | **219** | **219** | **212** | **186** | **184** | **173** | **171** | **153** | **159** |
| **Flota Total** | **272** | **283** | **317** | **339** | **433** | **446** | **449** | **415** | **405** | **373** | **373** | **345** | **351** |

El crecimiento continuo de la flota arrastrera ha ocurrido de manera anárquica, sin un plan concebido de desarrollo basado en la situación de los recursos o en la productividad de las áreas de pesca que tradicionalmente explotan. Este crecimiento se debió principalmente a la bonanza económica experimentada por el país durante las décadas de los 70 y 80 y a los atractivos precios del camarón en los mercados internacionales, ocasionando una sobrecapitalización de la flota. Debido a ello, la flota creció significativamente entre los años 1960 y 1984, al pasar de 23 a 240 unidades en ese período (incremento del 943%; Giménez, 1993). Durante el período 1985-1991 la flota mantuvo su crecimiento, aunque a un ritmo interanual menor, incrementándose en un 87%, al pasar de 240 a 449 unidades en 1991, año en que se logra el mayor tamaño de la flota (Tabla 2). Desde entonces la flota se redujo progresivamente hasta llegar a 351 unidades en 1997. Desde el inicio de la pesca de arrastre hasta 1989, la flota de la zona occidental (base en Falcón) fue la más importante en cuanto a tamaño. A partir de 1990 es reemplazada por la flota de la zona oriental, que alcanzó su mayor desarrollo en 1991, con 224 unidades.

En relación con la distribución por zona y puerto base, se aprecia en la Tabla 2 que a partir de 1988 la flota de la zona oriental fue la de mayor desarrollo al incorporarse un total de 62 unidades entre 1988 y 1991 (37 %). De esta flota, ha sido la de Cumaná la de mayor crecimiento al incorporarse un total de 29 unidades entre 1998 y 1991. Así mismo, la flota con base en Güiria (estado Sucre) también experimentó un notable crecimiento incrementándose en un 245%, al pasar de 20 en 1986 a 69 unidades en 1992. Por último, la flota de la zona Central ha sido la menos importante del país, ya que se ha mantenido estabilizada alrededor de 5 embarcaciones en los últimos seis años.

**TABLA 2. Características estructurales de la flota de arrastre venezolana en el perído 1996-98**

| ESLORA (m) | 1996 | 1997 | 1998 |
|---|---|---|---|
| 5,1 - 10 | 2 | 2 | 2 |
| 10,1 - 15 | 8 | 7 | 7 |
| 15,1 - 20 | 59 | 58 | 55 |
| 20,1 - 25 | 217 | 201 | 192 |
| 25,1 - 30 | 86 | 88 | 90 |
| 30,1 - 35 | 4 | 6 | 7 |
| 35,1 - 40 | 0 | 0 | 0 |
| 40,1 - 45 | 1 | 1 | 0 |
| | | | |
| POTENCIA (HP) | | | |
| 1.0 – 200 | 2 | 2 | 2 |
| 201 – 400 | 32 | 29 | 25 |
| 401 – 600 | 218 | 203 | 196 |
| 601 – 800 | 42 | 42 | 41 |
| 801 – 1000 | 75 | 78 | 81 |
| 1001 – 1200 | 6 | 6 | 6 |
| 1201 – 1400 | 1 | 1 | 1 |
| 1401 – 1600 | 1 | 2 | 1 |
| | | | |
| T.R.B. (t) | | | |
| 0,1 – 50 | 10 | 9 | 8 |
| 50,1 – 100 | 60 | 57 | 56 |
| 100,1 - 150 | 176 | 163 | 166 |
| 150,1 - 200 | 104 | 114 | 107 |
| 200,1 - 250 | 21 | 15 | 13 |
| 250,1 - 300 | 4 | 3 | 2 |
| 300,1 - 350 | 1 | 1 | 1 |
| 350,1 - 400 | 0 | 0 | 0 |
| 400,1 - 450 | 0 | 0 | |
| 450,1 - 500 | 0 | 0 | |
| 500,1 - 550 | 0 | 0 | |
| 550,1 - 600 | 1 | 1 | |
| TOTAL | 377 | 363 | 353 |

Actualmente la mayor parte de la pesca de arrastre (80%) es efectuada mediante embarcaciones de acero, las cuales se caracterizan por la gran heterogeneidad de sus características estructurales y su poder de pesca.

En cuanto a las características estructurales, se puede apreciar en la Tabla 1 que las unidades tienen un tamaño comprendido entre 15 y 34 metros de eslora, ubicándose la mayoría (54%) en la clase comprendida entre los 20-25 metros. En cuanto a la potencia de motor, se pueden encontrar embarcaciones entre 120 y 1600 HP, siendo la clase más importante la comprendida entre los 400-600 HP y entre los 800-1.000, en las cuales se ubican el 56 y 23%, respectivamente, del total de la flota. Por último, el Tonelaje de Registro Bruto (TRB) de la flota varia entre 50 y 300 toneladas, ubicándose la mayoría de las unidades en las clases 100-150 y 151-200, con el 47 y 30% respectivamente.

### 2.4 Desembarques

En la presente sección se presenta un análisis de los desembarques de la flota de arrastre de Venezuela, su evolución y tendencia en el tiempo. Dicho análisis se realiza por zona de pesca y grupos de camarones, moluscos y peces.

Desde el inicio de la pesquería (1956) hasta 1991 la tendencia observada en los desembarques totales fue hacia el aumento, cuando pasan de 4.000 a 42.443 toneladas, representando un incremento del 961 %. El volumen reportado representó, además, el 12% del total pesquero nacional. A partir de ese año y hasta 1993 los desembarques experimentaron un notable descenso, ubicándose alrededor de las 30.000 toneladas (una disminución del 29%). Después de una recuperación en 1994, cuando alcanzaron 38.000 toneladas métricas, los desembarques durante los siguientes años se caracterizan por una continua disminución, hasta 1997 cuando se desembarcan 26.000 toneladas (Tabla 3). La evolución de los desembarques totales, así como sus variaciones interanuales, están íntimamente asociadas a los cambios en tamaño experimentado por la flota nacional y a los niveles de esfuerzo desarrollados por la misma.

Al analizar la evolución de los desembarques por grupo de especies, se destaca en los tres últimos años que el camarón aportó entre el 16 y 21%, los moluscos entre el 9 y 12%, y los peces entre el 70 y 78% del total desembarcado por la flota a escala nacional (Tabla 3). Los desembarques de camarones a escala nacional fueron incrementándose hasta 1971, cuando se desembarcaron alrededor de 11.000 toneladas, cifra máxima lograda en la historia de la pesquería. A partir de ese año las cifras de desembarcos oscilaron hasta llegar alrededor de las 3.600 toneladas en 1997, la cifra más baja reportada en los últimos 25 años. La tendencia observada en la evolución de los desembarques de los moluscos (calamares, pulpo y conchas) es la de un continuo incremento hasta 1989, año en que se logran los mayores reportes, con unas 5.000 toneladas. Desde ese año hasta 1991, la tendencia fue hacia la de una disminución leve, ya que entre 1992 y 1995 la reducción fue más acentuada. En 1997 se observa una fuerte recuperación, en relación con los dos años anteriores. El grupo de los peces ha mostrado una tendencia similar de incremento interanual, desde el inicio de la pesquería hasta 1991 cuando se reportaron más de 32.000 toneladas. Sin embargo, durante la evolución de la pesquería se pueden observar marcadas fluctuaciones interanuales (Fig. 2).

El grupo de los camarones comprende distintas especies, pertenecientes en su mayoría a la familia Penaeidae. Comercialmente se clasifican en tres grupos: camarón marrón, blanco y titi. En la Tabla 4 se aprecia que durante la historia de la pesquería, ha sido la zona Occidental la mayor productora de camarones, específicamente el golfo de Venezuela (a excepción de los años 1991 y 1992), cuyo aporte a los desembarques nacionales oscila alrededor del 60 %, seguida en orden de importancia por la oriental y la central.

La evolución de los desembarques muestra que entre 1956 y 1989 se observaron pocas fluctuaciones, a excepción del golfo de Venezuela donde hubo un incremento elevado entre 1956 y 1970, para luego disminuir marcadamente hasta 2.000 toneladas métricas en 1983. A partir de ese año las fluctuaciones interanuales fueron menos acentuadas, estabilizándose, con excepción de algunos años, alrededor de las 3.000 toneladas. Estas fluctuaciones obedecen fundamentalmente a migraciones e intercambios de embarcaciones entre la zona occidental y oriental.

**TABLA 3. Desembarque (t) por grupo de especies reportado por la flota de arrastre venezolana. Período 1956-97**

| AÑO | CAMARON | MOLUSCOS | PECES | TOTAL |
|---|---|---|---|---|
| 56 | 641 | | 3364 | 4005 |
| | 900 | | 3835 | 4735 |
| 58 | 998 | | 3990 | 4988 |
| | 1403 | | 4695 | 6098 |
| 60 | 765 | | 3058 | 3823 |
| | 1298 | | 3693 | 4991 |
| 62 | 2037 | | 4330 | 6367 |
| | 2225 | | 5458 | 7683 |
| 64 | 1868 | | 5318 | 7186 |
| | 4135 | | 5263 | 9398 |
| 66 | 2471 | | 6354 | 8825 |
| | 4708 | | 5992 | 10700 |
| 68 | 3189 | | 5668 | 8857 |
| | 3069 | | 5457 | 8526 |
| 70 | 8137 | 148 | 4822 | 13107 |
| | 10972 | 1158 | 6778 | 18908 |
| 72 | 8655 | 2949 | 11418 | 23022 |
| | 7671 | 2290 | 11321 | 21282 |
| 74 | 7887 | 3531 | 16382 | 27800 |
| | 7035 | 2618 | 16149 | 25802 |
| 76 | 8069 | 1889 | 14092 | 24050 |
| | 7370 | 2082 | 17664 | 27116 |
| 78 | 5363 | 1960 | 14334 | 21657 |
| | 4132 | 914 | 13260 | 18306 |
| 80 | 4719 | 1757 | 12849 | 19325 |
| | 4314 | 908 | 13795 | 19017 |
| 82 | 5003 | 1740 | 15320 | 22063 |
| | 3893 | 3071 | 14310 | 21274 |
| 84 | 4276 | 3610 | 18676 | 26562 |
| | 5217 | 2431 | 24735 | 32383 |
| 86 | 4577 | 3258 | 21005 | 28840 |
| | 3716 | 3498 | 24901 | 32115 |
| 88 | 3841 | 5246 | 17582 | 26669 |
| | 7163 | 4886 | 27088 | 39137 |
| 90 | 6649 | 3594 | 26779 | 37022 |
| | 5826 | 4466 | 32151 | 42443 |
| 92 | 4156 | 1957 | 23739 | 29852 |
| | 5214 | 3007 | 23052 | 31273 |
| 94 | 4392 | 3079 | 31330 | 38801 |
| | 4900 | 1929 | 23451 | 30280 |
| 96 | 4504 | 1824 | 14657 | 20985 |
| | 3665 | 3231 | 19352 | 26248 |

Los moluscos, grupo integrado por calamares, pulpo y conchas, se capturan principalmente en las zonas oriental y occidental del país. La evolución histórica de los desembarques de este grupo se presenta con incrementos altamente significativos entre 1970 y 1989, al pasar de 118 a 4.886 toneladas métricas, representando un incremento del 4.041% durante el período. A partir de ese año los niveles de desembarques disminuyeron considerablemente con marcadas fluctuaciones interanuales a escala nacional, situándose actualmente alrededor de 3.000 toneladas métricas. La zona oriental aporta más del 75% de la producción nacional (Tabla 5).

**TABLA 4. Desembarques de camarones (t), reportados por la flota de arrastre venezolana**

| | REGION | | | |
|---|---|---|---|---|
| AÑO | ORIENTAL | CENTRAL | OCCIDENTAL | TOTAL |
| 1956 | | | 641 | 641 |
| 1957 | | | 900 | 900 |
| 1958 | | | 998 | 998 |
| 1959 | | | 1403 | 1403 |
| 1960 | | | 765 | 765 |
| 1961 | | | 1298 | 1298 |
| 1962 | | | 2037 | 2037 |
| 1963 | | | 2225 | 2225 |
| 1964 | | | 1868 | 1868 |
| 1965 | | | 4135 | 4135 |
| 1966 | | | 2471 | 2471 |
| 1967 | | | 4708 | 4708 |
| 1968 | | | 3189 | 3189 |
| 1969 | | | 3069 | 3069 |
| 1970 | 385 | | 7752 | 8137 |
| 1971 | 1100 | | 9872 | 10972 |
| 1972 | 1021 | | 7634 | 8655 |
| 1973 | 3154 | 71 | 4446 | 7671 |
| 1971 | 1943 | 86 | 5855 | 7884 |
| 1975 | 2406 | 128 | 4501 | 7035 |
| 1976 | 2434 | 128 | 5507 | 8069 |
| 1977 | 2785 | 135 | 4450 | 7370 |
| 1978 | 1542 | 145 | 3676 | 5363 |
| 1979 | 1578 | 144 | 2410 | 4132 |
| 1980 | 1760 | 126 | 2833 | 4719 |
| 1981 | 1670 | 100 | 2544 | 4314 |
| 1982 | 2176 | 76 | 5751 | 8003 |
| 1983 | 1721 | 106 | 2066 | 3893 |
| 1984 | 1781 | 147 | 2348 | 4276 |
| 1985 | 1860 | 90 | 3267 | 5217 |
| 1986 | 1024 | 75 | 3478 | 4577 |
| 1987 | 1442 | 93 | 2181 | 3716 |
| 1988 | 1298 | 103 | 2440 | 3841 |
| 1989 | 1880 | | 4546 | 6426 |
| 1990 | 2354 | 185 | 4001 | 6540 |
| 1991 | 2804 | 232 | 2790 | 5826 |
| 1992 | 2458 | 209 | 1489 | 4156 |
| 1993 | 2399 | 172 | 2644 | 5215 |
| 1994 | 1646 | 139 | 2608 | 4393 |
| 1995 | 1797 | 153 | 2950 | 4900 |
| 1996 | 1405 | 31 | 3068 | 4504 |
| 1997 | 1083 | 48 | 2534 | 3665 |

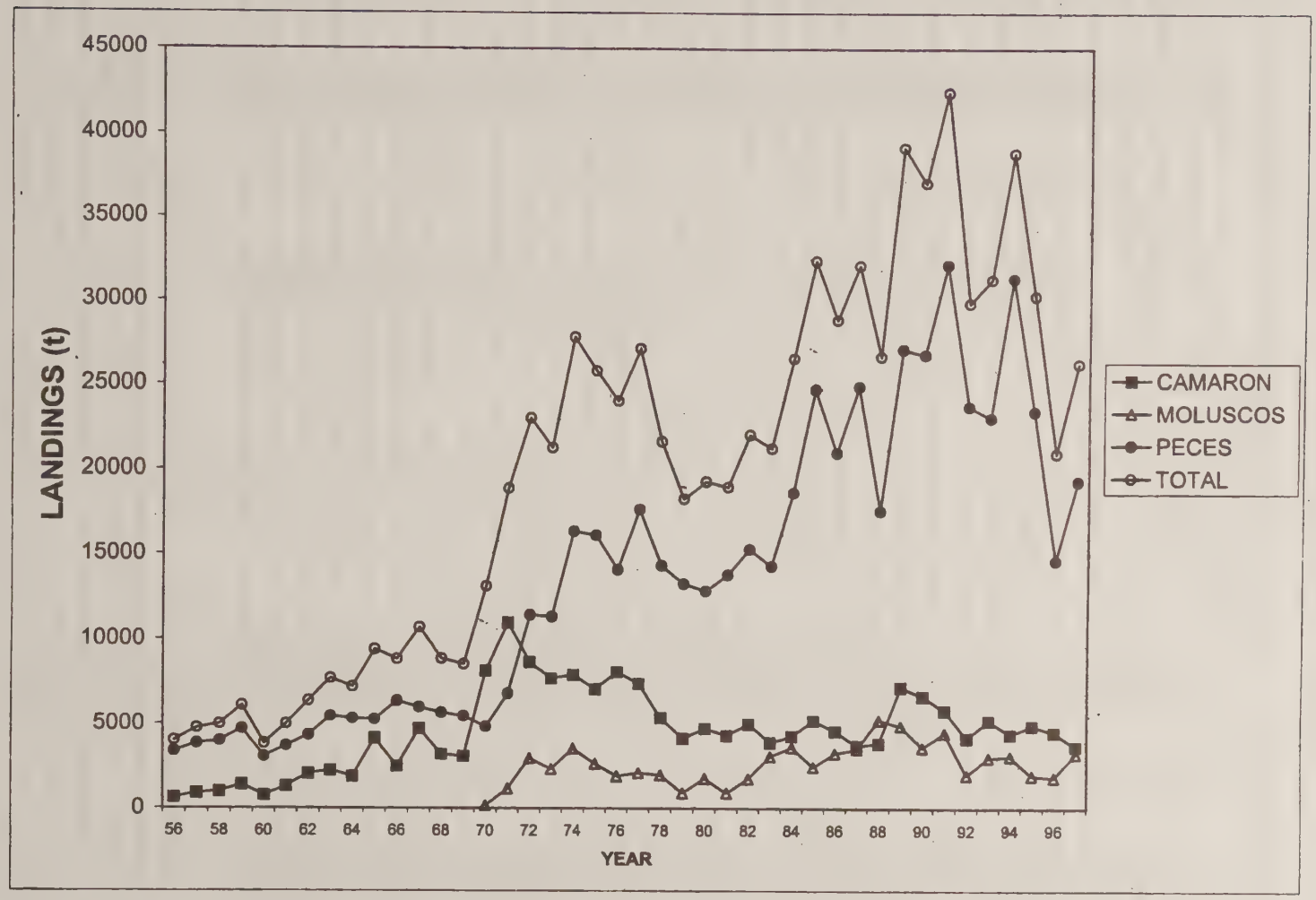



**Figure 2. National landings from the trawl fleet in Venezuela durig 1956-97**

Los peces reportados por la flota de arrastre están integrados por una serie de especies comerciales conocidas vulgarmente como: corocoros, catalana, curvinatas, curvina, roncador, lamparosa, cherechere, perla, cazones, picúas, pargo guanapo tahalí, pámpano, chicharra, panchito, lenguados, entre otros. Estas especies no necesariamente están presentes en todas las zonas, de manera que algunas son especies indicadoras de áreas por ser de hábitat específicos (Novoa, *et al.* 1982 y 93; Mendoza, *et al.* 1994; Marcano *et al.* 1998; Salaya *et al.* 1980).

**TABLA 5. Desembarques de moluscos (t) por región reportados por la flota de arrastre venezolana, período 1970-97**

| | | REGION | | |
|---|---|---|---|---|
| AÑO | ORIENTAL | CENTRAL | OCCIDENTAL | TOTAL |
| 1970 | 118 | | | 118 |
| 1971 | 633 | | 525 | 1158 |
| 1972 | 2114 | | 885 | 2999 |
| 1973 | 750 | | 1540 | 2290 |
| 1971 | 1277 | | 2254 | 3531 |
| 1975 | 1831 | | 787 | 2618 |
| 1976 | 1333 | | 556 | 1889 |
| 1977 | 1226 | | 856 | 2082 |
| 1978 | 1734 | | 226 | 1960 |
| 1979 | 719 | | 195 | 914 |
| 1980 | 699 | | 436 | 1135 |
| 1981 | 474 | | | 474 |
| 1982 | 976 | | | 976 |
| 1983 | 1634 | | | 1634 |
| 1984 | 1911 | | | 1911 |
| 1985 | 1278 | | | 1278 |
| 1986 | 1721 | | | 1721 |
| 1987 | 1883 | | | 1883 |
| 1988 | 2759 | | | 2759 |
| 1989 | 4886 | | | 4886 |
| 1990 | 2817 | | 777 | 3594 |
| 1991 | 3386 | | 1080 | 4466 |
| 1992 | 1726 | | 232 | 1958 |
| 1993 | 1993 | | 1014 | 3007 |
| 1994 | 2222 | | 857 | 3079 |
| 1995 | 1497 | | 432 | 1929 |
| 1996 | 1576 | | 248 | 1824 |
| 1997 | 2396 | 2 | 833 | 3231 |

Desde el inicio de la pesquería hasta 1988, se destaca la zona occidental como la mayor productora de pescado a escala nacional, llegando a reportar hasta 17.000 toneladas métricas (1987), seguida de la oriental. A partir de 1989 (a excepción de 1990 y 1994), la zona oriental pasó a ser la más importante en cuanto a volúmenes de peces desembarcados. La tendencia en los desembarques totales ha sido de un crecimiento continuo desde el principio de la década de los 70 hasta 1991, aunque con ciertas fluctuaciones interanuales debido a un incremento en los desembarques de las zonas más importantes. A partir de 1992, los desembarques experimentaron fuertes descensos interanuales, ubicándose actualmente alrededor de las 20.000 toneladas métricas (Tabla 6).

Uno de los esfuerzos más significativos realizados en el país en relación con la pesca de arrastre, fue el desarrollado por un equipo de investigadores designado por la máxima autoridad de pesca. El mismo consistió en realizar un análisis del estado actual de las pesquerías de arrastre en cada una de las zonas y áreas de pesca. Mediante la aplicación de modelos de producción y dinámicos se pudieron evaluar las pesquerías, estimándose el Rendimiento Máximo Sostenible (RMS) y el Esfuerzo Optimo (Eop) por

área de pesca. Los resultados de estos análisis sirvieron de base para establecer un nuevo plan de ordenación de las pesquerías, mediante la asignación y control del esfuerzo de pesca en cada área por parte de Comités Locales de Seguimiento (CLOSE) constituidos en cada zona (Novoa y Marcano

**TABLA 6. Desembarques de peces (t) por región reportados por la flota dearrastre venezolana, período 1956-97**

| | REGION | | | |
|---|---|---|---|---|
| AÑO | ORIENTAL | CENTRAL | OCCIDENTAL | TOTAL |
| 1956 | | | 3364 | 3364 |
| 1957 | | | 3835 | 3835 |
| 1958 | | | 3990 | 3990 |
| 1959 | | | 4695 | 4695 |
| 1960 | | | 3058 | 3058 |
| 1961 | | | 3693 | 3693 |
| 1962 | | | 4330 | 4330 |
| 1963 | | | 5458 | 5458 |
| 1964 | | | 5318 | 5318 |
| 1965 | | | 5263 | 5263 |
| 1966 | | | 6154 | 6154 |
| 1967 | | | 5992 | 5992 |
| 1968 | | | 5668 | 5668 |
| 1969 | | | 5457 | 5457 |
| 1970 | 2001 | | 2821 | 4822 |
| 1971 | 3224 | | 3554 | 6778 |
| 1972 | 5819 | | 5599 | 11418 |
| 1973 | 6853 | 216 | 4207 | 11276 |
| 1971 | 7802 | 399 | 8181 | 16382 |
| 1975 | 9059 | 500 | 6590 | 16149 |
| 1976 | 8128 | 739 | 5225 | 14092 |
| 1977 | 10073 | 1146 | 6445 | 17664 |
| 1978 | 9106 | 1085 | 4143 | 14334 |
| 1979 | 7124 | 227 | 5909 | 13260 |
| 1980 | 5924 | 219 | 6436 | 12579 |
| 1981 | 7317 | 272 | 6206 | 13795 |
| 1982 | 8943 | 170 | 6207 | 15320 |
| 1983 | 6175 | 203 | 7932 | 14310 |
| 1984 | 8243 | 237 | 10196 | 18676 |
| 1985 | 9711 | 145 | 14879 | 24735 |
| 1986 | 6193 | 119 | 14693 | 21005 |
| 1987 | 7962 | 148 | 16791 | 24901 |
| 1988 | 7139 | 168 | 10275 | 17582 |
| 1989 | 14327 | | 12761 | 27088 |
| 1990 | 13152 | 315 | 13312 | 26779 |
| 1991 | 18038 | 453 | 13661 | 32152 |
| 1992 | 14145 | 348 | 9246 | 23739 |
| 1993 | 14103 | 211 | 8738 | 23052 |
| 1994 | 11027 | 241 | 20062 | 31330 |
| 1995 | 13633 | 264 | 9554 | 23451 |
| 1996 | 7359 | 76 | 7222 | 14657 |
| 1997 | 10679 | 189 | 8484 | 19352 |

1996). Este plan se inició en 1996 y en los tres años de ejecución los resultados obtenidos han sido muy satisfactorios. El control más preciso de esta actividad ha conducido a la reducción en un 14% del esfuerzo de pesca a escala nacional en los tres años de ejecución que tiene el programa, mientras que por zona la reducción fue de 16, 9 y 15% para la zona oriental, central y occidental, respectivamente.

## 3. FLOTA Y ESFUERZO DE PESCA POR REGIÓN

### 3,1 Golfo de Venezuela

*Flota*

Desde el inicio de la pesquería de arrastre, la flota con base en Punto Fijo (región occidental) ha operado principalmente en áreas del golfo de Venezuela y ha estado integrada, en su mayoría, por embarcaciones que funcionan mediante el sistema de pesca tipo florida.

La pesquería de arrastre en esta región es la más antigua del país y se ha mantenido como la de mayor importancia, de acuerdo a los volúmenes de captura de peces y de camarones que representan más del 50% de las descargas de la flota nacional.

Desde el mismo inicio de la pesquería en la región occidental (1956) el numero de unidades que ha integrado esta flota ha fluctuado marcadamente, debido a que muchas embarcaciones han migrado hacia otras regiones de pesca donde se han establecido de manera definitiva, tomando como puerto de operaciones las ciudades de Cumana, Puerto la Cruz y Güiria, en la región oriental. No obstante que en entre 1989 y 1991 esta flota alcanzó su mayor expansión al contar con más de 430 unidades, en los últimos cinco años el numero de unidades se ha reducido considerablemente, estabilizándose alrededor de 350 embarcaciones (Tabla 2).

*Esfuerzo de pesca*

El esfuerzo de pesca (expresado en días de ausencia del puerto) desarrollado en el área del Golfo de Venezuela ha sido el de mayor magnitud generado por la flota, llegando a representar más del 60% del esfuerzo a escala nacional. Al igual que el numero de unidades que integra la flota, el esfuerzo ha variado considerablemente, destacándose el período 1989-1991 como el de mayor actividad de la pesquería cuando superó los 40.000 días de ausencia. A partir de 1992 la tendencia ha sido a disminuir, estabilizándose alrededor de los 25.000 días. (Tabla 7).

### 3.2 Margarita y Norte de Sucre

*Flota*

Esta flota se ha caracterizado por ser bastante homogénea. En la actualidad la mayoría de las embarcaciones tienen un tamaño comprendido entre los 20-29 metros de eslora y entre 400 y 850 HP de motor principal. A partir de 1994 se han incorporado a la flota unidades que superan los 30 metros de eslora, con motores que superan los 1.000 HP de potencia (Tabla 1). Estas últimas, por lo general, se dedican a la captura de peces en la zona de la Guayana venezolana.

La historia evolutiva de esta flota, indica que en el inicio de la pesquería (1970) estuvo integrada por 14 unidades (Tabla 2). En 1974 llegó a contar con 95 embarcaciones como resultado de la migración de unidades desde el occidente del país, debido a los bajos rendimientos de camarones en el golfo de Venezuela. A partir de 1975, entró en un período de disminución hasta llegar a 52 unidades en 1980. En 1981 comienza su proceso de recuperación, incrementándose en 219% entre ese año y 1991, cuando alcanza su máxima expansión con 169 unidades. A partir de 1992, la tendencia fue a disminuir, estabilizándose alrededor de 100 embarcaciones en los últimos cuatro años, con excepción de 1994. Para 1997 y 1998 se observa un incremento en el número de unidades que operó en la zona, al pasar de 101 en 1996 a 116 y 136 unidades en 1997 y 1998 respectivamente, representando un incremento superior al 30 %. Dicho incremento obedece al traslado de embarcaciones con puerto base en Güiria, para desarrollar actividades de manera definitiva en áreas de Margarita y norte de Sucre.

**TABLA 7. Desembarques (t) por especies reportados por la flota de arrastre que opera en el Golfo de Venezuela**

| ESPECIE | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GUANAPO | 315 | 223 | 368 | 315 | 260 | 358 | 355 | 310 | 286 | 389 | 529 | 336 | 261 | 599 | 354 | 200 | 384 | 414 | 279 |
| COROCORO | 914 | 1077 | 468 | 908 | 1399 | 1953 | 1797 | 1989 | 612 | 592 | 977 | 1840 | 1533 | 2484 | 1128 | 2037 | 1382 | 1754 | 2149 |
| MERLUZA | 488 | 632 | 611 | 698 | 518 | 799 | 823 | 786 | 566 | 521 | 408 | 250 | 167 | 1247 | 169 | 84 | 83 | 217 | 87 |
| RONCADOR | 1705 | 1574 | 1154 | 1313 | 1683 | 2100 | 1934 | 1583 | 1135 | 1522 | 2382 | 2233 | 1645 | 3443 | 1742 | 2123 | 1893 | 1748 | 2127 |
| CURBINATA | 368 | 482 | 423 | 549 | 497 | 449 | 403 | 549 | 383 | 280 | 540 | 658 | 636 | 1019 | 893 | 698 | 359 | 362 | 530 |
| CAZON | 90 | 90 | 26 | 39 | 41 | 47 | 50 | 38 | 21 | 22 | 24 | 24 | 18 | 125 | 31 | 53 | 10 | 5 | 0 |
| CARITE | 137 | 59 | 138 | 53 | 35 | 59 | 14 | 96 | 95 | 70 | 125 | 52 | 15 | 135 | 41 | 9 | 14 | 13 | 0 |
| CATACO | 83 | 40 | 19 | 21 | 13 | 15 | 16 | 7 | 0 | 0 | 0 | 0 | 0 | 49 | 0 | 0 | 0 | 0 | 0 |
| CATALANA | 0 | 0 | 22 | 36 | 49 | 91 | 36 | 172 | 138 | 127 | 151 | 89 | 52 | 96 | 83 | 53 | 87 | 104 | 127 |
| LAMPAROSA | 240 | 161 | 147 | 278 | 171 | 211 | 95 | 383 | 380 | 309 | 474 | 439 | 363 | 486 | 431 | 523 | 332 | 465 | 456 |
| LENGUADO | 0 | 0 | 6 | 21 | 48 | 18 | 10 | 26 | 7 | 7 | 5 | 8 | 14 | 17 | 0 | 0 | 0 | 0 | 0 |
| BAGRE | 38 | 122 | 69 | 119 | 125 | 150 | 92 | 148 | 114 | 121 | 205 | 172 | 93 | 263 | 189 | 193 | 163 | 98 | 154 |
| MOJARRA | 0 | 0 | 4 | 6 | 21 | 41 | 24 | 65 | 54 | 69 | 60 | 68 | 42 | 46 | 90 | 99 | 107 | 80 | 87 |
| PICUA | 202 | 205 | 121 | 155 | 117 | 131 | 52 | 206 | 212 | 153 | 173 | 123 | 81 | 357 | 123 | 94 | 88 | 78 | 74 |
| ROBALO | 0 | 0 | 0 | 0 | 0 | 115 | 41 | 84 | 65 | 74 | 70 | 83 | 98 | 63 | 114 | 99 | 91 | 111 | 136 |
| PERLA | 0 | 0 | 192 | 0 | 579 | 555 | 243 | 453 | 283 | 353 | 433 | 472 | 354 | 392 | 251 | 236 | 162 | 199 | 224 |
| TAHALI | 289 | 267 | 116 | 358 | 620 | 643 | 251 | 1098 | 583 | 676 | 1803 | 2185 | 1476 | 1248 | 1240 | 1802 | 1154 | 1365 | 1327 |
| CHICHARRA | 0 | 0 | 166 | 81 | 359 | 515 | 255 | 1158 | 904 | 862 | 1555 | 1457 | 754 | 807 | 885 | 776 | 515 | 418 | 486 |
| CACHICATO | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 79 | 37 | 0 |
| RAYA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 70 | 110 | 83 |
| FILETE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 5 | 4 | 0 |
| JUREL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 22 | 12 |
| LISA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 5 | 3 | 0 |
| VARIOS | 1582 | 1307 | 983 | 858 | 314 | 315 | 1893 | 613 | 452 | 720 | 1122 | 970 | 632 | 2194 | 710 | 650 | 642 | 798 | 961 |
| TOT. PEC | 6450 | 6240 | 5032 | 5806 | 6849 | 8567 | 8385 | 9764 | 6290 | 6867 | 11036 | 11461 | 8234 | 15069 | 8475 | 9825 | 7634 | 8406 | 9298 |
| CAMARONES | 2951 | 2789 | 1943 | 1462 | 1792 | 2671 | 3207 | 1893 | 1755 | 2913 | 3279 | 2349 | 1459 | 2283 | 2369 | 3071 | 2730 | 2281 | 1643 |
| CAM TITI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 167 | 11 | 23 | 69 | 22 | 29 | 0 | 0 | 0 | 1 | 0 |
| CANGREJO | 52 | 0 | 31 | 27 | 45 | 33 | 13 | 29 | 52 | 40 | 50 | 79 | 37 | 43 | 41 | 47 | 31 | 38 | 31 |
| TOT.INVERT. | 3794 | 3104 | 2740 | 2460 | 3334 | 3791 | 4255 | 2598 | 2825 | 4252 | 3966 | 3308 | 1719 | 3650 | 3160 | 3284 | 3010 | 3102 | 1895 |
| GRAL. (PEC.+INVERT.) | 10244 | 9344 | 7771 | 8266 | 10183 | 12358 | 12640 | 12362 | 9115 | 11119 | 15002 | 14768 | 9953 | 18719 | 11635 | 13109 | 10644 | 11509 | 11193 |
| PULPO | 251 | 18 | 26 | 32 | 98 | 76 | 19 | 15 | 7 | 396 | 17 | 46 | 28 | 94 | 91 | 17 | 30 | 314 | 103 |
| CALAMAR | 433 | 297 | 712 | 924 | 1357 | 916 | 974 | 634 | 839 | 889 | 587 | 682 | 165 | 1165 | 612 | 128 | 206 | 459 | 107 |
| VIEIRA | 106 | 0 | 28 | 15 | 42 | 95 | 43 | 27 | 4 | 4 | 10 | 83 | 8 | 36 | 47 | 20 | 12 | 11 | 12 |
| TOT.MOLUSC | 791 | 315 | 766 | 971 | 1497 | 1087 | 1036 | 676 | 851 | 1288 | 614 | 811 | 201 | 1295 | 750 | 166 | 248 | 783 | 221 |
| D. AUSENCIA | 20389 | 19589 | 17240 | 16033 | 20512 | 26129 | 29901 | 29146 | 26080 | 31091 | 42619 | 36582 | 22908 | 26766 | 29097 | 28868 | 25884 | 28956 | 24793 |

**TABLA 8. Desembarques (t) por especies reportados por la flota de arrastre que opera en áreas de Margarita y Norte de sucre**

| | ESPECIES | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AÑO | CAMARON | CANGREJO | CALAMAR | PULPO | CONCHAS | COROCORO | RONCADOR | CATALANA | CATACO | TONQUICHA | CAZON | LAMPAROSA | PICUA | OTRAS ESP. | TOTAL |
| 1970 | 143 | 7 | 23 | 14 | 73 | 298 | 90 | | | 32 | 63 | 42 | 3 | 121 | 909 |
| 1971 | 399 | 19 | 115 | 93 | 128 | 563 | 187 | 1 | 3 | 126 | 104 | 70 | 6 | 396 | 2210 |
| 1972 | 321 | 7 | 159 | 200 | 1252 | 692 | 179 | 12 | 8 | 141 | 101 | 54 | 9 | 1581 | 4716 |
| 1973 | 489 | 10 | 231 | 213 | 103 | 1225 | 320 | 47 | 52 | 251 | 168 | 89 | 31 | 1163 | 4392 |
| 1974 | 531 | 12 | 489 | 412 | 113 | 1241 | 260 | 237 | 172 | 261 | 253 | 244 | 95 | 1292 | 5612 |
| 1975 | 466 | 9 | 578 | 460 | 301 | 1923 | 237 | 392 | 384 | 393 | 256 | 214 | 91 | 1612 | 7316 |
| 1976 | 529 | 6 | 434 | 451 | 206 | 1817 | 190 | 250 | 284 | 377 | 235 | 121 | 108 | 1402 | 6410 |
| 1977 | 400 | 9 | 551 | 156 | 200 | 1224 | 201 | 551 | 248 | 338 | 172 | 76 | 70 | 2577 | 6773 |
| 1978 | 389 | 3 | 926 | 332 | 181 | 2119 | 358 | 119 | 281 | 356 | 165 | 301 | 98 | 1773 | 7401 |
| 1979 | 372 | 15 | 380 | 55 | 214 | 1583 | 317 | 137 | 391 | 229 | 149 | 87 | 113 | 1378 | 5420 |
| 1980 | 368 | 43 | 279 | 80 | 263 | 1203 | 232 | 152 | 229 | 133 | 139 | 131 | 94 | 1047 | 4393 |
| 1981 | 321 | 32 | 294 | 111 | 29 | 1206 | 217 | 76 | 288 | 152 | 122 | 53 | 64 | 1045 | 4010 |
| 1982 | 450 | 34 | 325 | 357 | 82 | 1214 | 264 | 88 | 306 | 147 | 280 | 50 | 46 | 2335 | 5978 |
| 1983 | 402 | 54 | 492 | 934 | 11 | 1054 | 174 | 146 | 445 | 121 | 81 | 47 | 29 | 1082 | 5072 |
| 1984 | 856 | 41 | 540 | 817 | 342 | 1788 | 317 | 179 | 251 | 164 | 464 | 128 | 70 | 2638 | 8595 |
| 1985 | 826 | 26 | 386 | 487 | 280 | 1849 | 509 | 192 | 269 | 644 | 567 | 133 | 74 | 2511 | 8753 |
| 1986 | 749 | 44 | 675 | 600 | 262 | 1499 | 419 | 205 | 288 | 300 | 225 | 138 | 79 | 2051 | 7534 |
| 1987 | 695 | 208 | 814 | 548 | 253 | 1121 | 284 | 194 | 242 | 171 | 90 | 143 | 42 | 1572 | 6377 |
| 1988 | 725 | 221 | 1397 | 763 | 327 | 1085 | 255 | 251 | 272 | 149 | 168 | 82 | 38 | 1603 | 7336 |
| 1989 | 861 | 212 | 1567 | 1070 | 1873 | 1543 | 305 | 457 | 732 | 279 | 485 | 168 | 77 | 2644 | 12273 |
| 1990 | 722 | 173 | 763 | 777 | 743 | 699 | 298 | 601 | 669 | 242 | 340 | 176 | 56 | 1847 | 8106 |
| 1991 | 838 | 185 | 837 | 1250 | 434 | 600 | 234 | 327 | 500 | 233 | 248 | 141 | 50 | 1429 | 7306 |
| 1992 | 866 | 154 | 489 | 459 | 378 | 741 | 238 | 276 | 251 | 218 | 178 | 164 | 40 | 1425 | 5877 |
| 1993 | 706 | 103 | 505 | 412 | 763 | 562 | 150 | 209 | 234 | 128 | 127 | 126 | 29 | 994 | 5048 |
| 1994 | 449 | 86 | 504 | 635 | 327 | 354 | 63 | 277 | 144 | 54 | 105 | 66 | 11 | 667 | 3742 |
| 1995 | 575 | 200 | 224 | 468 | 171 | 436 | 86 | 178 | 251 | 49 | 78 | 200 | 13 | 776 | 3800 |
| 1996 | 560 | 79 | 370 | 820 | 171 | 436 | 86 | 178 | 251 | 49 | 78 | 133 | 17 | 833 | 4061 |
| 1997 | 387 | 61 | 406 | 698 | 634 | 266 | 77 | 557 | 189 | 84 | 90 | 225 | 14 | 803 | 4491 |
| 1998 | 590 | 62 | 524 | 781 | 119 | 427 | 158 | 307 | 243 | 4 | 96 | 354 | 22 | 1123 | 4810 |

*Esfuerzo*

Las áreas de pesca localizadas alrededor de la isla de Margarita y norte del estado Sucre se han caracterizado por ser, desde el mismo inicio de la pesca de arrastre en la región nororiental, las de mayor actividad y mayor atracción de la flota con base en Cumaná. El esfuerzo de pesca generado en ellas ha sido el mayor de las tres zonas de pesca de la región (Tabla 8).

Hasta 1989, el esfuerzo de pesca en la zona se había incrementado considerablemente al desarrollarse en ese año un nivel de esfuerzo equivalente a 22.538 días de ausencia, el mayor en toda la historia de la pesquería. A partir de 1990, la actividad experimentó un descenso, situándose alrededor de los 10.000 días en los años más recientes. En los dos últimos años, la flota experimentó un incremento de su actividad en la zona, manteniendo su esfuerzo alrededor de los 12.500 días de ausencia de puerto. Estos niveles de esfuerzo son superiores a los generados el 1994 y 1995. Ello obedece, principalmente, a las alzas en los precios del combustible, cuyo incremento fue del 900 %, al pasar de Bs. 5,00 a 48,00 por litro. Esto obligó a que las embarcaciones de mayor edad y las menos eficientes de Cumaná que operaban regularmente en la zona de las Guayanas, decidieran no seguir operando en ella, tomando como zona de pesca a las áreas situadas alrededor de Margarita y norte de Sucre.

### 3.3 Margen Atlantico de las Guyanas

*Flota*

Desde el inicio de la actividad pesquera en el Margen Atlántico de las Guayanas, la flota de barcos arrastreros que allí opera ha estado integrada por embarcaciones con puerto base en Cumaná y Güiria. A partir de 1990, se incorporaron a la zona 12 unidades con puerto base en Punta Meta, estado Anzoátegui, cuyos desembarques fueron realizados en el Puerto Internacional de Güiria y/o en su puerto de origen (Marcano *et al.*, 1998).

Las características estructurales de la flota han mantenido las proporciones observadas en 1991, manteniéndose entre 21 y 30 metros de eslora, donde se ubican más del 80% de las unidades. La potencia del motor principal de la mayoría (85%) de las embarcaciones se encuentran entre 401 y 850 HP.

La historia evolutiva de la flota, se ha caracterizado por marcadas fluctuaciones en relación al número de unidades que la han integrado, detectándose tres períodos bien definidos. Entre ellos se destaca el comprendido entre 1988 y 1993, cuando la flota experimentó su mayor desarrollo, al incrementarse de 75 a 141 unidades en 1993 (Tabla 2). A partir de 1994, la flota disminuye hasta llegar a 66 unidades en 1996, niveles similares a los observados entre 1978 y 1986, para luego experimentar un ascenso en 1997, cuando en la zona operaron 96 unidades de pesca. Actualmente el tamaño de la flota es de 87 unidades de pesca. El descenso observado en 1994 y 1995 fue motivado a que unidades con puerto base en Güiria cambiaron de puerto y de zona de operación. Mientras que el descenso de 1996, se debió a una reducción de hasta el 60% (de 68 a 28) en el número de unidades con puerto base en Cumaná, que operaron en la zona en 1995, y al cese total de actividades de las embarcaciones con puerto base en Punta Meta. Para 1997, nuevas unidades de Cumaná y Punta Meta reiniciaron actividades en la zona. El comportamiento de la flota para ese año fue en respuesta al incremento del 960% en el costo del combustible y lubricantes, a partir de marzo de 1996, que dejó fuera de la zona a las unidades más viejas, pequeñas y poco eficientes en el uso del mismo, a pesar del subsidio de un 33% otorgado a la actividad pesquera industrial (Marcano, *et al.*, 1998a).

*Esfuerzo*

La historia evolutiva del esfuerzo de pesca, expresado en días de ausencia de puerto, desarrollado en la zona ha sido muy heterogénea, caracterizado por los marcados cambios interanuales experimentados por la actividad pesquera en la región (Tabla 9). Al igual que en la flota, se aprecia en el esfuerzo períodos evolutivos bien definidos, caracterizados por la incorporación y retiro de unidades de pesca a la actividad pesquera de la región. Destacándose, así mismo, el período comprendido entre 1988 y 1993 como el de máxima actividad en la zona. Se generaron en el mismo, niveles de esfuerzo superiores a los 12.000 días de ausencia. A partir de 1994 el esfuerzo de pesca experimentó un notable descenso, al disminuir hasta 6.952 días en 1997. Para 1998 el esfuerzo alcanzó 8.669 días. La mayor disminución en 1997 fue por parte de las unidades procedentes de Cumaná, las cuales redujeron su actividad en la zona en un 35%, en relación con 1995, mientras que las unidades con base en Punta Meta cesaron por completo su actividad en la zona hasta 1996, reanudándola en 1997. Las razones que explican el comportamiento del esfuerzo en la zona son similares a las que explicaron el comportamiento de la flota

### 3.4 Plataforma Unare – Píritu

*Flota*

De las tres flotas de arrastre que operan en la región oriental, la ubicada en los puertos de Guanta y Punta Meta, que opera principalmente en la plataforma de Unare, ha sido la de menor desarrollo durante su historia evolutiva, a pesar de ser la primera que se estableció en la región. Al igual que las otras flotas, sus características estructurales no han variado significativamente en los diez últimos años.

En 1970 esta flota contaba con 10 unidades tipo florida. A partir de ese año experimentó un fuerte crecimiento hasta 1976 cuando llegó a estar conformada por 59 unidades en 1972, cifra máxima alcanzada por la flota. Entre 1977 y 1986 el tamaño de la flota decreció manteniéndose estabilizada alrededor de 24 unidades de pesca. Entre 1989 y 1990 experimenta un crecimiento, similar a los observados en los primeros cinco años, cuando se observan 51 unidades. Actualmente existen 30 embarcaciones en operación.

*Esfuerzo*

En la evolución del esfuerzo de pesca se pueden diferenciar tres períodos bien definidos en la zona (Tabla 10). El primero comprendido entre 1970 y 1978, cuando las fluctuaciones interanuales fueron bien marcadas, oscilando entre 1.380 y 5.239 días de ausencia de puerto. Fue máximo en 1973, cuando la flota alcanza su mayor tamaño. El segundo período es considerado el de mayor expansión de la flota, ya que la tendencia apreciada fue hacia un crecimiento rápido y se extiende desde 1979 hasta 1989. Se lograron en ese período los mayores índices de esfuerzo, al desarrollar la flota más de 7.000 días de pesca. Un tercer período, entre 1990 y 1997, caracterizado por un decrecimiento del esfuerzo en la zona de pesca. A pesar de que los índices de esfuerzo en 1995 y 1996 fueron los más bajos del período en 1998, se aprecia una ligera recuperación de la actividad de pesca en la zona.

## 4. DESEMBARQUES

### 4.1 Golfo de Venezuela

En la Tabla 7 se presentan los desembarques anuales totales, y clasificados por rubros, explotados en áreas del Golfo de Venezuela durante el período 1980-1998. Se debe destacar la importancia de esta flota por su aporte a la producción nacional de arrastre que representan cerca del 60% del total nacional.

Los desembarques totales, reportados desde esta región durante el período en cuestión, han fluctuado marcadamente al variar entre las 7.000 y 18.000 toneladas métricas, con evidentes cambios interanuales. En 1982 se reportaron lo desembarques más bajos del período de estudio, con menos de 8.000 toneladas métricas, mientras que en 1993 se reportaron los máximos desembarques provenientes del Golfo. Sin embargo, la tendencia observada en los últimos cinco años es hacia la disminución, estabilizándose alrededor de las 11.000 toneladas métricas.

El análisis de los desembarques indica que los mismos están conformados por más de 60 especies o grupos de especies de peces, crustáceos y moluscos. Sin embargo, diez (10) de ellas representan más del 70% de los desembarques reportados. Los desembarques totales han sido clasificados en rubros, de acuerdo a la importancia de los mismos; los más importantes para esta pesquería son los camarones cuyo aporte ha sido en promedio del 19% en los últimos cuatro años; los moluscos (pulpo, calamar y concha) aportan el 3% y por último los peces que aportan en promedio el 78% de los desembarques totales. Los camarones están conformados por cinco especies pertenecientes a la familia Penaeidae: *Farfantepenaeus brasiliensis* (rosado con manchas), *F. notialis (rosado)*, *F. Subtilis* (tres especies que conforman lo que se conoce comercialmente como complejo marrón); *F. schmitti* (blanco) y *Xyphopenaeus. kroyerii* (titi). De estas especies, la más importante es *F. subtilis*, cuyo aporte a las capturas totales del rubro es superior al 50 %.

**TABLA 9. Esfuerzo, captura (t) y CPUE (cpue) reportados por la flota arrastrera que opera en el Golfo de Paria y costas del delta del Rio Orinoco, durante el periodo 1979-98**

| | ESFUERZO | | CAMARON | TOTAL | CAMARON BLANCO | | CAMARON MARRON | | PECES | | CAPTURA TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AÑO | FLOTA | DIAS | CPUE | CAPTURA | CPUE | CAPTURA | CPUE | CAPTURA | CPUE | CAPTURA | CPUE | CAPTURA |
| 73 | 136 | 8208 | 244 | 2000 | 73 | 605 | 170 | 1395 | 97 | 800 | 341 | 2800 |
| 74 | 92 | 4552 | 154 | 701 | 8 | 35 | 146 | 666 | 371 | 1689 | 525 | 2390 |
| 75 | 105 | 7712 | 181 | 1398 | 50 | 386 | 131 | 1012 | 231 | 1783 | 412 | 3181 |
| 76 | 90 | 7275 | 202 | 1473 | 18 | 129 | 185 | 1344 | 304 | 2208 | 506 | 3681 |
| 77 | 117 | 8956 | 232 | 2075 | 6 | 53 | 226 | 2022 | 379 | 3398 | 611 | 5473 |
| 78 | 58 | 4256 | 192 | 818 | 6 | 26 | 186 | 792 | 436 | 1856 | 628 | 2674 |
| 79 | 51 | 4879 | 193 | 940 | 27 | 130 | 166 | 810 | 349 | 1703 | 542 | 2643 |
| 80 | 58 | 5307 | 181 | 960 | 43 | 227 | 137 | 733 | 408 | 2197 | 595 | 3157 |
| 81 | 68 | 6670 | 138 | 919 | 10 | 66 | 128 | 853 | 488 | 3252 | 625 | 4171 |
| 82 | 85 | 6120 | 193 | 1180 | 61 | 371 | 132 | 809 | 567 | 3470 | 760 | 4650 |
| 83 | 70 | 5474 | 173 | 946 | 69 | 378 | 104 | 568 | 299 | 1637 | 472 | 2583 |
| 84 | 64 | 3305 | 195 | 646 | 7 | 22 | 189 | 624 | 521 | 1723 | 717 | 2369 |
| 85 | 66 | 3223 | 176 | 566 | 38 | 121 | 138 | 445 | 763 | 2459 | 939 | 3025 |
| 86 | 75 | 6719 | 124 | 836 | 30 | 55 | 113 | 762 | 483 | 3244 | 607 | 4080 |
| 87 | 94 | 7171 | 123 | 885 | 11 | 74 | 100 | 714 | 497 | 3569 | 621 | 4454 |
| 88 | 98 | 8710 | 125 | 1087 | 24 | 171 | 99 | 859 | 646 | 5630 | 771 | 6717 |
| 89 | 135 | 13252 | 107 | 1421 | 26 | 228 | 90 | 1191 | 542 | 7186 | 649 | 8607 |
| 90 | 140 | 13011 | 110 | 1433 | 17 | 230 | 83 | 1078 | 537 | 6987 | 647 | 8420 |
| 91 | 136 | 9952 | 117 | 1162 | 27 | 355 | 78 | 780 | 615 | 6119 | 732 | 7281 |
| 92 | 121 | 12762 | 98 | 1257 | 18 | 182 | 70 | 888 | 736 | 9397 | 835 | 10654 |
| 93 | 141 | 8851 | 78 | 692 | 29 | 369 | 60 | 531 | 766 | 6781 | 844 | 7473 |
| 94 | 119 | 4043 | 103 | 415 | 18 | 161 | 89 | 360 | 680 | 2749 | 783 | 3164 |
| 95 | 114 | 9348 | 99 | 927 | 34 | 316 | 65 | 610 | 714 | 6670 | 813 | 7597 |
| 96 | 66 | 6727 | 76 | 510 | 28 | 188 | 48 | 322 | 649 | 4368 | 725 | 4878 |
| 97 | 96 | 6952 | 44 | 306 | 8 | 54 | 36 | 252 | 802 | 5577 | 846 | 5883 |
| 98 | 87 | 8669 | 73 | 636 | 23 | 200 | 50 | 436 | 712 | 6176 | 786 | 6812 |

*- Camarones*

Los desembarques de este rubro han variado durante el período de estudio entre 1.600 y 3.250 toneladas métricas, siendo máximos en 1990 y mínimos en 1998. Como en toda pesquería de camarones, las fluctuaciones anuales de los desembarques son, en algunos casos, bastantes marcadas, como consecuencia de cambios ambientales y procesos ecológicos ocurridos en la región que inciden en los procesos de reclutamiento de los camarones, y motivado también a la intensidad del esfuerzo de pesca artesanal de camarones que se desarrolla en áreas del lago de Maracaibo, donde los mismos cumplen ciertas fases de su ciclo vital.

*- Moluscos*

Los moluscos están representados por los calamares (*Loligo pealei* y *L. plei*), el pulpo (*Octopus vulgaris*) y la concha vieira (*Amusium papiraceum*). Constituyen un rubro de alta importancia comercial, pero su aporte a los desembarques totales ha venido disminuyendo considerablemente. En este rubro, los calamares siempre han sido el grupo de mayor importancia, representando más del 80% de los desembarques totales. Sin embargo, en los dos últimos años el pulpo ha incrementado su participación en los mismos. Por último, la concha vieira, la especie que menos aporta al rubro, ha reducido su participación considerablemente en los años más recientes.

*- Peces*

Los desembarques de peces reportados por la flota de arrastre que opera en esta región están conformados por más de 40 especies de interés comercial. Sin embargo, ocho de ellas son consideradas las de mayor importancia. Las mismas aportan más del 60 %, del 78% que representan los peces en los desembarques totales. Las especies de peces más importantes que conforman este rubro son: corocoro (*Orthopristis ruber*); roncador (*Micropogonias furnieri*); tahalí (*Trichiurus lepturus*); chicharra (*Chloroscombrus chrysurus*); curvinata (*Macrodon ancylodon*); lamparosa (*Selene setapinnis),* pargo guanapo (*Lutjanus synagris*) y perla (*Lepophidium profundorum)* (Novoa *et al.*, 1993). La evolución de los desembarques de este rubro se ha caracterizado por ligeras fluctuaciones interanuales, manteniéndose alrededor de las 7.000 toneladas métricas durante el período de estudio, no obstante que entre 1990 y 1993 los desembarques fueron los mayores reportados por esta flota, alcanzando niveles superiores a las 11.000 toneladas métricas.

La composición por especie para 1998, señala que el mayor aporte a este rubro lo proporcionaron las especies corocoro y roncador, ambas con el 16% del total de peces reportado por la flota, seguidas del tahalí (10%), chicharra (4%) y curvinata (4%). Se puede apreciar que estas cinco especies aportaron más del 50% de los desembarques totales de peces reportados.

### 4.2 Margarita y Norte de la Peninsula de Paria

En la Tabla 8 se incluyen los desembarques anuales totales, clasificados por rubros explotados en áreas de Margarita y norte de Sucre, durante el período 1970-1998.

Los desembarques totales reportados desde esta zona, han fluctuado marcadamente al variar entre 1.000 y 12.000 toneladas métricas, con evidentes cambios interanuales. En 1989 se reportaron las mayores capturas (12.000 toneladas métricas). Sin embargo, hasta 1995, la tendencia era a disminuir, manteniéndose alrededor de las 4.000 toneladas métricas, con ligeros aumentos en los tres últimos años. El incremento observado en el último año es debido principalmente a los peces y al camarón, ya que los desembarques de moluscos experimentaron un descenso por el orden del 18 %, al pasar de 1.738 a 1.424 toneladas métricas. Se puede apreciar que los desembarques totales obedecen a cambios experimentados en la actividad de la flota desarrollada en la zona, encontrándose una relación directa entre ambos índices pesqueros.

Los resultados del análisis de los desembarques indican que los mismos están conformados por más de 45 especies o grupos de especies de peces, crustáceos y moluscos. Sin embargo, de esta amplia diversidad trece (13) de ellas representan más del 76% de los desembarques reportados desde el área de estudio (Tabla. 8). En la misma se aprecia que desde el mismo inicio de esta pesquería, los desembarques se han caracterizado por estar conformados principalmente por peces, no obstante que las unidades de pesca que integran la flota están orientadas a la captura del camarón, para la cual usan artes específicos. Sin embargo, en los últimos cinco años algunas de estas embarcaciones dirigen su esfuerzo a la captura de peces específicamente (Marcano, 1998a).

Los desembarques totales han sido clasificados en rubros, de acuerdo a la importancia de los mismos; los más importantes para esta pesquería son los crustáceos (camarones y cangrejos) que aportan el 14% a los desembarques totales; los moluscos (pulpo, calamar y concha) aportan el 30%, y por último los peces que aportan el 56% de los desembarques totales. Los camarones están representados por las especies *Farfantepenaeus brasiliensis* (rosado con manchas) en un 98% y *F. notialis (rosado)*, que representa el 2% restante. Los cangrejos (2 %) están representados comercialmente por especies del género Calappa (*C. sulcata, C. flamea y C. nitida*).

*- Camarones*

La evolución de los desembarques de camarones presenta un primer período que se extiende desde su inicio hasta 1983, con tendencias a estabilizarse cerca de las 400 toneladas métricas. Se observa un segundo período que se extiende hasta 1993, en el cual las capturas alcanzaron sus máximos valores, situándose alrededor de 800 toneladas métricas por año. Por último, un tercer período donde las capturas experimentaron una marcada reducción, equivalente al 38 %, en relación al período anterior (Tabla 8). Los máximos desembarques fueron reportados en los años 1989 y 1992, con más de 870 toneladas métricas. Aunque en 1998 se aprecia una ligera recuperación, es de señalar que las capturas reportadas en 1997 representan las más bajas logradas en los últimos 17 años de la actividad de pesca de arrastre industrial desarrolladas en áreas de Margarita y norte de Sucre.

Llama la atención la reducción tan evidente de las descargas de camarones durante los últimos años de la serie histórica. Se considera que el impacto de la venta ilegal de camarones en alta mar sobre las estadísticas de captura puede ser severo, habiéndose estimado que las capturas reportadas representan solamente el 40% de las capturas reales (J. Alió y L. Marcano, datos no publicados).

*- Moluscos*

Los moluscos, representados por los calamares (*Loligo pealei* y *L. plei*), el pulpo (*Octopus vulgaris*) y la concha vieira (*Amusium papiraceum*), constituyen el segundo rubro en importancia económica para la flota de arrastre. Las capturas han evolucionado con marcadas fluctuaciones interanuales, aumentado considerablemente hasta 1989 cuando se logran desembarcar 4.500 toneladas métricas (Tabla 8). Sin embargo, la tendencia observada a partir de ese año y hasta 1996 es hacia la disminución progresiva, hasta alcanzar niveles de capturas próximas a las 1.000 toneladas métricas. En los últimos dos años se aprecia una ligera recuperación en los desembarques de este rubro. Hasta 1993 los calamares eran el grupo de especies predominante en las capturas de moluscos, siendo desplazados por el pulpo a partir de 1994. En 1998 el pulpo representó 55% de los desembarques de moluscos en el área.

*- Peces*

Entre las especies más importantes que conforman este rubro se pueden citar: corocoro (*Orthopristis ruber*); roncador (*Micropogonias furnieri*); cataco (*Trachurus lathami*); catalana (*Priacanthus arenatus*); tonquicha (*Cynoscion jamaicensis*); cazón (*Rhizoprionodon porosus*); lamparosa (*Selene vomer);* panchito (*Pristhipomoides aquilonaris*) (Novoa *et al.*,1980; Mendoza *et al.*, 1994; Marcano *et al.*, 1982; 1996).

Los desembarques de este rubro se han caracterizado por marcadas fluctuaciones, durante la historia evolutiva de la pesquería de arrastre en la zona de estudio. Los mismos han oscilado entre 656 y 6.911 toneladas métricas en el período 1970-1996 (Tabla 8). Los máximos valores de rendimiento fueron reportados en los años 1984, 1985 y 1989 al desembarcarse más de 6.000 toneladas métricas por año. Sin embargo, la tendencia observada en los últimos siete años es hacia una marcada disminución, sin señales de una posible recuperación, no obstante que el esfuerzo se ha mantenido estabilizado alrededor de los 10.000 días de ausencia de puerto. A pesar de esta tendencia, en 1998 se observó un ligero incremento (17%) con relación a los tres años anteriores. La composición por especie para 1998, señala que el mayor aporte a este rubro lo proporcionaron las especies: corocoro (19%), lamparosa (13%), catalana (11%), cataco (9%), roncador (6%) y el cazón (4%), los cuales contribuyen con 59% de los desembarques totales de peces reportados por las flotas que operan en el área de estudio.

### 4.3 Margen Atlantico de las Guyanas (Golfo de Paria y delta del Rio Orinoco)

Esta pesquería se ha caracterizado por ser, en los últimos diez años, la de mayor rendimiento en la región, aunque la descarga total sea menor que en otras regiones de pesca. Las descargas durante 1994 se redujeron hasta llegar a 2.700 toneladas, representando una disminución superior al 60% en relación a 1993 (Tabla 9). Después de un período de oscilaciones, su incremento entre 1986 y 1993 fue notable, considerándose como el período de máximo desarrollo de la pesquería, llegándose a reportar

desembarques superiores a las 10.000 toneladas métricas. El comportamiento anual de los desembarques totales ha estado condicionado por el comportamiento de los desembarques de peces, dado que, cada vez son aprovechados en mayor proporción (Marcano *et al.*, 1996). De igual forma, la actividad de la flota en la región también ha incidido en este comportamiento, toda vez que existe una relación directa entre estos dos índices, es decir, a cambios en el esfuerzo hay una respuesta similar en las capturas de peces.

La composición por especie indica que los desembarques están constituidos preferentemente por peces, cuyo aporte a los desembarques totales fue del 91% en 1998, siendo el aporte de los camarones el 9% restante. No se descargan moluscos en esta pesquería (Tabla 9).

- *Camarones*

La evolución en la composición muestra que, durante los primeros años de esta pesquería, los camarones representaron un elevado porcentaje, llegando a participar hasta con el 71% (Marcano, 1977). Esta situación obedeció a la condición de desembarcar solamente una pequeña fracción de los peces capturados. A medida que los peces han sido principalmente aprovechados, la representación de los camarones en la captura fue disminuyendo, sin indicar ello que la captura de este rubro haya disminuido significativamente. A partir de 1989 y hasta 1992 se observa una tendencia al aumento en los desembarcos de camarones. La representación del camarón en las capturas está actualmente estabilizada cerca del 9 %.

El rubro camarón está conformado por tres especies: blanco (*Farfantepenaeus schmitti*), marrón (*F. subtilis*) y rosado con manchas *(F. brasiliensis*). Dentro de este complejo el camarón marrón es el más abundante, representando el 95% aproximadamente de los desembarques (Novoa, 1974; Montesinos *et al.*, 1980; Marcano *et al.*, 1992). Este complejo ha llegado a conformar más del 90% de las capturas de camarones. El aporte del camarón blanco en algunos años ha sido superior al 25 %, económicamente es el más importante para la flota por el gran tamaño que alcanza en la zona (Altuve *et al.*, 1992). Las diferencias en las capturas de camarones obedecen a que la flota opera preferentemente en áreas cuya profundidad oscila entre 10-20 brazas, donde el camarón marrón es más abundante. El camarón blanco es más abundante a profundidades entre 4-10 brazas, áreas donde la topografía de los fondos dificulta la operación de la flota (Marcano *et al.*, 1992).

La evolución anual de las descargas de camarones señala marcadas fluctuaciones, tanto para el camarón marrón como para el blanco (Tabla 9). En el caso del camarón blanco se observa una tendencia, aunque leve, al incremento en los últimos 8 años, mientras que para el complejo del camarón marrón la tendencia es hacia la disminución, lográndose para 1997 los niveles de capturas más bajos del período (252 toneladas métricas), aunque para 1998 se observó un incremento del 50 %. Para este año, el aporte del camarón blanco llegó al 31 %, mientras que el marrón contribuyó con el 69% a las capturas totales de este rubro.

Se estima que las fluctuaciones en las capturas de camarones está asociada a los procesos de reclutamiento, como consecuencia de los cambios en las condiciones ambientales, posiblemente asociadas a cambios en los niveles del río Orinoco o a los sistemas de corrientes marinas locales afectadas por los vientos predominantes (Alió *et al.*, 1999).

- *Peces*

Los desembarques de peces se han caracterizado por su relativo bajo volumen (Tabla 9), a pesar de que la región ha sido caracterizada como la de mayor abundancia de peces, estimándose su potencial en 100.000 toneladas métricas por año (Anónimo, 1990). A partir de 1987, los desembarques de peces se han incrementado consideradamente, llegándose a reportar desembarques cercanos a las 10.000 toneladas métricas en 1993, pero los mismos experimentaron un descenso en 1996, cuando se desembarcaron alrededor de 4.368 toneladas. Para 1998, los desembarques de peces alcanzaron 6.000 toneladas métricas. El incremento experimentado por los desembarques de peces ha sido debido, principalmente, al interés de los empresarios en traer hasta puerto la totalidad de las capturas. Los elevados índices de abundancia de camarones y el poco valor de los peces en el mercado en años anteriores motivaron a los industriales a aprovechar solamente una pequeña fracción de la captura de peces.

La captura por especie de peces señala para el período 1987-1997, que las especies pertenecientes a la familia Sciaenidae (curvinata, curvina y roncador) aportan más del 75% de los desembarques totales de peces. Este comportamiento obedece a las condiciones hidrobiológicas de la región, que se caracteriza

por la baja salinidad de sus aguas. Otras especies importantes en esta pesquería son la lamparosa, bagres, guanapo, tahalí y cazones (Tabla 11).

Dentro de los Sciaenidos, la curvinata (*Macrodon ancylodon*) es la especie más importante por su volumen de captura. Aunque la curvina (*Cynosción virescens*) y el roncador (*Micropogonias furnieri*), son especies importantes, en los últimos 6 años, la curvinata es la especie que ha condicionado el comportamiento de los desembarques de peces, ya que su aporte ha sido superior al 60% (Tabla 11).

### 4.4 Plataforma Unare – Píritu

Esta pesquería se ha caracterizado por ser la más discreta de las tres que se realizan en la región, en cuanto a sus rendimientos y abundancia de los recursos pesqueros. Los volúmenes de captura procedentes de esta zona son los más bajos de la región (Tabla 10).

La historia evolutiva de los desembarques totales presentó durante los primeros diez años una tendencia hacia el incremento, lográndose en 1972 los mayores desembarques reportados desde la zona, con un total de 4.242 toneladas métricas. A partir de 1979, entran en una etapa de decrecimiento hasta 1988, con una tendencia a estabilizarse alrededor de las 1.500 toneladas métricas. En 1989, experimentan un repunte hasta alcanzar un total de 4.025 toneladas métricas. Finalmente, entre 1990 y 1998 la tendencia es a disminuir y a estabilizarse alrededor de las 1.000 toneladas métricas.

La composición por rubro, de los desembarques procedentes de esta zona, indica que los peces representan un 75%, los camarones un 17% y los moluscos el 8% restante. Así mismo, un análisis a las capturas de los invertebrados de interés comercial para la flota señala a los camarones como el grupo más importante, ya que su aporte se ubica para 1998 en 67%, el calamar en segundo lugar con 18%, el pulpo con el 14% y por último los cangrejos con el 15%.

*- Camarones*

En esta zona, el rubro camarones está constituido por dos especies: el camarón blanco, *Lithopenaeus schmitti* y el camarón marrón; *Farfantepenaeus brasiliensis*. De éstos, el marrón es el más importante, ya que representa más del 85% de los desembarques totales de camarones procedentes de la zona. Los desembarques de este rubro se incrementaron fuertemente entre 1970 y 1974, al pasar de 242 a 711 toneladas métricas, los máximos desembarques reportados desde la zona. A partir de 1975 entran en un proceso de fuertes fluctuaciones hasta 1989 cuando experimentan un notable repunte, al desembarcarse un total de 684 toneladas métricas. (Tabla 10). Desde 1990 hasta 1998 se reportan los desembarque más bajos en la historia de esta pesquería, alcanzándose en 1998 un total de 163 toneladas métricas.

*- Moluscos*

Este rubro está constituido por moluscos cefalópodos, representado por calamares y pulpo. De estos, los calamares tienen mayor importancia en cuanto a volúmenes de desembarques se refiere, con un aporte de 57%, pero económicamente el pulpo es más importante por el valor alcanzado en los mercados.

Los desembarques de este rubro se han caracterizado por presentar marcadas fluctuaciones interanuales, entre 38 y 492 toneladas métricas, a través de su historia evolutiva. Durante los ocho primeros años de la pesquería se reportaron los mayores desembarques de este rubro (Tabla 10). A partir de 1979 entran en el período de mayores variaciones, hasta 1994 cuando se logran desembarcar un total de 376 toneladas métricas, la segunda descarga más importante en la historia de esta pesquería. En los tres últimos años entran en un proceso de marcada disminución, desembarcándose un total de 79 toneladas métricas en 1998, uno de los más bajos en la historia de esta pesquería.

*- Peces*

La tendencia observada en los desembarques de este rubro entre 1970 y 1998, muestra un rápido incremento entre 1970 y 1972 al pasar de 1.387 a 3.089 toneladas métricas (Tabla 10). A partir de

**TABLA 10. Captura (t) de las principales especies de peces desembarcada por la flota arrastrera que opera en la Plataforma Unare – Píritu, durante el periodo 1970-97**

| | CAMARÓN | | | MOLUSCOS | | PECES | | | | | | | | | ESPEC | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AÑO | BLANCO | MARRÓN | TITI | CALAMAR | PULPO | RONCADOR | COROCORO | TONQUICHA | CAZON | LAMAPARO | CATACO | PERLA | CATALANA | TAHALI | VARIAS | TOTAL |
| 1970 | 10 | 208 | 24 | 27 | 11 | 146 | 249 | 68 | 121 | 52 | | | | | 715 | 1631 |
| 1971 | 228 | 442 | 31 | 139 | 158 | 248 | 255 | 215 | 119 | 114 | | | | | 817 | 2766 |
| 1972 | 151 | 485 | 64 | 190 | 263 | 367 | 573 | 458 | 220 | 144 | | | | | 1280 | 4195 |
| 1973 | 129 | 498 | 38 | 115 | 88 | 288 | 446 | 482 | 165 | 111 | | | | | 1215 | 3575 |
| 1974 | 199 | 429 | 83 | 129 | 134 | 220 | 258 | 442 | 118 | 111 | | | | | 909 | 3032 |
| 1975 | 165 | 312 | 65 | 370 | 122 | 129 | 215 | 233 | 66 | 97 | | | | | 877 | 2651 |
| 1976 | 24 | 352 | 56 | 142 | 100 | 84 | 149 | 135 | 69 | 65 | | | | | 634 | 1810 |
| 1977 | 0 | 299 | 11 | 243 | 76 | 110 | 167 | 184 | 41 | 58 | | | | | 658 | 1847 |
| 1978 | 13 | 322 | 0 | 232 | 63 | 180 | 268 | 265 | 123 | 108 | | | | | 736 | 2310 |
| 1979 | 9 | 251 | 0 | 66 | 4 | 77 | 53 | 50 | 47 | 49 | | | | | 395 | 1001 |
| 1980 | 105 | 327 | 0 | 64 | 13 | 79 | 19 | 104 | 52 | 70 | | | | | 313 | 1146 |
| 1981 | 182 | 232 | 16 | 37 | 3 | 79 | 26 | 106 | 3 | 97 | | | | | 531 | 1312 |
| 1982 | 236 | 261 | 49 | 80 | 132 | 71 | 46 | 18 | 19 | 60 | | | | | 529 | 1501 |
| 1983 | 149 | 203 | 21 | 82 | 115 | 101 | 81 | 29 | 19 | 56 | | | | | 1073 | 1929 |
| 1984 | 17 | 306 | 57 | 107 | 133 | 57 | 51 | 27 | 19 | 26 | | | | | 902 | 1702 |
| 1985 | 173 | 314 | 45 | 74 | 69 | 51 | 49 | 29 | 11 | 32 | | | | | 889 | 1736 |
| 1986 | 52 | 446 | 10 | 142 | 68 | 87 | 68 | 38 | 9 | 29 | 62 | 101 | 28 | 43 | 636 | 1819 |
| 1987 | 17 | 366 | 0 | 187 | 119 | 79 | 153 | 77 | 13 | 44 | 105 | 114 | 50 | 85 | 1020 | 2429 |
| 1988 | 50 | 410 | 7 | 202 | 108 | 87 | 58 | 111 | 7 | 64 | 115 | 102 | 42 | 71 | 427 | 1861 |
| 1989 | 40 | 640 | 3 | 267 | 74 | 250 | 107 | 247 | 63 | 27 | 13 | 10 | 20 | 21 | 2240 | 4022 |
| 1990 | 25 | 310 | 5 | 155 | 78 | 66 | 23 | 26 | 9 | 23 | 96 | 116 | 45 | 69 | 626 | 1672 |
| 1991 | 66 | 301 | 13 | 239 | 64 | 61 | 13 | 27 | 4 | 26 | 36 | 142 | 0 | 77 | 389 | 1458 |
| 1992 | 35 | 279 | 1 | 161 | 19 | 55 | 17 | 11 | 5 | 46 | 8 | 112 | 8 | 55 | 582 | 1394 |
| 1993 | 10 | 260 | 1 | 177 | 56 | 48 | 32 | 10 | 7 | 40 | 9 | 99 | 27 | 28 | 441 | 1245 |
| 1994 | 16 | 278 | 0 | 263 | 100 | 76 | 38 | 32 | 17 | 48 | 17 | 160 | 46 | 36 | 504 | 1631 |
| 1995 | 44 | 202 | 0 | 67 | 12 | 57 | 28 | 116 | 30 | 56 | 33 | 82 | 37 | 38 | 500 | 1302 |
| 1996 | 63 | 173 | 0 | 121 | 42 | 54 | 46 | 25 | 14 | 79 | 39 | 81 | 31 | 36 | 429 | 1233 |
| 1997 | 31 | 160 | 0 | 95 | 30 | 49 | 36 | 17 | 14 | 84 | 32 | 59 | 42 | 49 | 234 | 932 |
| 1998 | 0 | 163 | 0 | 45 | 34 | 71 | 38 | 17 | 15 | 114 | 21 | 52 | 35 | 34 | 341 | 980 |

1973 los desembarques de peces comienzan a disminuir progresivamente hasta 1988, mostrando ciertos altibajos interanuales. En 1989 experimentan un repunte hasta llegar a 3.000 toneladas métricas, para luego disminuir nuevamente hasta llegar a 616 toneladas métricas en 1997, los más bajos reportados en esta nueva etapa de la historia de la pesquería. En 1998 se observó una leve recuperación al desembarcarse alrededor de 730 toneladas métricas, representando un incremento del 29%.

La composición por especie de este rubro indica que está conformado por una gran diversidad de especies, sin embargo, ocho de ellas representan más del 52% del total. Las especies más importantes son: corocoro (5%), tonquicha (2%), perla (7%), tahalí (5%), catalana (5%), roncador (10%), lamparosa (15%) y cataco (3%; Tabla 10).

**TABLA 11. Captura (t) de las principales especies de peces descargadas y esfuerzo (dias de ausencia) de la flota arrastrera que opera en la zone Atlántica de Venezuela, durante el periodo 1987**

| AÑO | Roncador | Curvina | Curbinata | P. guanapo | Bagres | Lamparosa | Tahalí | Tiburones | Otros | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| **1987** | 620 | 887 | 446 | 105 | 113 | 164 | 38 | 223 | 644 | 3244 |
| **1988** | 922 | 567 | 535 | 155 | 165 | 136 | 20 | 235 | 591 | 3569 |
| **1989** | 870 | 910 | 1363 | 80 | 27 | 195 | 52 | 314 | 1574 | 5630 |
| **1990** | 818 | 858 | 1927 | 110 | 456 | 518 | 159 | 219 | 2120 | 7186 |
| **1991** | 745 | 974 | 2682 | 148 | 519 | 449 | 140 | 170 | 1165 | 6987 |
| **1992** | 611 | 798 | 2574 | 145 | 257 | 291 | - | 153 | 1290 | 6119 |
| **1993** | 840 | 1226 | 4082 | 148 | 436 | 526 | 221 | 196 | 1665 | 9340 |
| **1994** | 488 | 733 | 3610 | 119 | 230 | 266 | 125 | 130 | 1080 | 6781 |
| **1995** | 324 | 1017 | 4143 | 63 | 220 | 309 | 139 | 143 | 312 | 6670 |
| **1996** | 166 | 557 | 2696 | 34 | 200 | 158 | 137 | 65 | 355 | 4368 |
| **1997** | 262 | 628 | 3738 | 40 | 201 | 188 | 115 | 90 | 555 | 5817 |
| **1998** | 516 | 592 | 3820 | 131 | 226 | 189 | 145 | 62 | 497 | 6176 |

## 5. ANÁLISIS DE TALLA DE ESPECIES COMERCIALES COMPONENTES DE LA FAUNA ACOMPAÑANTE EN LA PESCA INDUSTRIAL DE ARRASTRE DEL CAMARÓN (FAC) DE LA REGIÓN NORORIENTAL DE VENEZUELA.

Entre las especies de peces descargados de mayor tamaño se destaca *Micropogonias furnieri,* que se captura en las tres zonas de pesca y cuya talla promedio supera los 35 centímetros, lográndose reportar ejemplares que superan los 60 centímetros de talla máxima. La curvina (*Cynoscion virescens*) es la especie de mayor tamaño integrante de la fauna acompañante, con talla promedio de 49 centímetros. Esta especie es reportada únicamente desde el Margen Atlántico. Aunque la curvinata (*Macrodon ancylodon*) está ubicada entre las especies de mayor tamaño, su importancia radica en los grandes volúmenes de capturas, procedentes de la misma zona de pesca. En áreas de pesca de Margarita y Unare, el *Orthopristis ruber* y *Priacanthus arenatus*, son las especies de mayor tamaño, con tallas promedio superiores a los 25 centímetros de longitud total. *Pristipomoides aquilonaris, Selene setapinnis* y *Haemulon steindachneri* son también especies que superan los 25 cm de longitud total promedio y de allí su importancia en los componentes de los desembarques de la región (Tabla 12).

**TABLA 12. Resultados del analisis de frecuencia de tallas de especies comerciales reportadas por la flota de arrastre de la región oriental de Venezuela**

| ESPECIE | AREA | N | MEDIA | DES. EST | MIN | MAX | % PARTICIPACION |
|---|---|---|---|---|---|---|---|
| *Farfantepenaeus brasiliensis* | Margarita | 2431 | 14.0 | 24.4 | 5 | 24 | 11 |
| *Farfantepenaeus notialis* | Margarita | 743 | 13.5 | 24.3 | 5 | 21 | 1 |
| *Orthopristis ruber* | Margarita | 2477 | 25.0 | 5.1 | 10 | 36 | 16 |
| *Priacanthus arenatus* | Margarita | 3123 | 25.5 | 3.4 | 10 | 43 | 11 |
| *Heamulon steindachnieri* | Margarita | 1578 | 21.1 | 3.9 | 13 | 32 | 3 |
| *Micropogonias furnieri* | Margarita | 1320 | 35.0 | 9.6 | 22 | 72 | 6 |
| *Pristipomoides aquilonaris* | Margarita | 630 | 24.1 | 3.2 | 18 | 30 | 2 |
| *Cynosción jamaicensis* | Margarita | 861 | 17.8 | 8.3 | 27 | 31 | 1 |
| *Amusium papyraceus* | Margarita | 1515 | 6.7 | 0.6 | 4 | 9 | 2 |
| *Octopus vulgaris* | Margarita | 1180 | 10.3 | 2.4 | 4 | 17 | 16 |
| *Calappa sulcata* | Margarita | 1028 | . 10.6 | 1.8 | 4.9 | 17.0 | 1 |
| *Farfantepenaeus schmitti* | N. G. Paria | 2134 | 13.2 | 2.1 | 6 | 20 | 100 |
| *F. schmitti* | Pedernales | 1875 | 11.4 | 1.4 | 6 | 18 | 98 |
| *F. schmitti* | M.Atlántico | 3546 | 18.2 | 2.2 | 7 | 23 | 3 |
| *F. subtilis* | M.Atlántico | 1518 | 11.0 | 1.5 | 6 | 18 | 6 |
| *Micropogonias furnieri* | M.Atlántico | 3756 | 38.7 | 10.2 | 24 | 72 | 8 |
| *Macrodon ancylodon* | M.Atlántico | 10807 | 26.3 | 3.4 | 18 | 39 | 62 |
| *Cynosción virescens* | M.Atlántico | 2655 | 45.8 | 10.9 | 20 | 87 | 10 |
| *Nebris microps* | M.Atlántico | 4063 | 27.5 | 4.1 | 16 | 39 | 3 |
| *Cynosción jamaicensis* | Unare-Pirítu | 801 | 27.3 | 2.8 | 9 | 45 | 2 |
| *Orthopristis ruber* | Unare-Pirítu | 358 | 22.9 | 3.3 | 12 | 34 | 5 |
| *Priacanthus arenatus* | Unare-Pirítu | 815 | 28.9 | 3.9 | 19 | 39 | 5 |
| *Lopophidium profundorum* | Unare-Pirítu | 1577 | 25.2 | 2.2 | 15 | 33 | 7 |
| *Loligo pealeii/plei* | Unare-Pirítu | 417 | 15.4 | 4.8 | 5 | 31 | 5 |
| *Selene setapinnis* | Unare-Pirítu | 457 | 26 | 4.2 | 21 | 38 | 15 |
| *Micropogonias furnieri* | Unare-Pirítu | 576 | 31 | 11,2 | 16 | 63 | 10 |

## 6. ANÁLISIS DE LA FAUNA ACOMPAÑANTE DEL CAMARÓN Y ENSAYOS PARA REDUCIR LOS DESCARTES EN LA PESCA INDUSTRIAL DE ARRASTRE

Como ya fue mencionado, la mayoría de las embarcaciones de arrastre usan un tipo similar de red destinada a la captura del camarón. Sin embargo, este último componente suele representar entre 2,5 y 6% de la captura total; de los otros componentes de fauna acompañante que se captura incidentalmente, se comercializan entre el 30 y el 35%, siendo descartado el restante 59-68% de la captura total (Marcano, 1998). La fracción descartada está compuesta de peces (96%), crustáceos (3%), moluscos (0,6%), y equinodermos y otros materiales (0,4%). Los peces entre la fauna de descarte son principalmente pequeños, en un 80% pertenecientes a especies de interés comercial. Antes de la introducción del TED también se llegaron a capturar algunas tortugas marinas, pero tan sólo alcanzaron a representar un 0,1% de los desembarques. En los últimos años se comercializan más especies de peces y de menor tamaño, debido al incremento en la demanda de pescado entre la población. Esto indujo una reducción general de los descartes de la flota, que se pudo evidenciar en la región oriental del país durante 1988-1992 (Tabla 13; Fig. 3). Después de 1992, la proporción de fauna descartada durante las operaciones de arrastre se elevó, posiblemente debido a una sobreexplotación de los recursos en las distintas regiones de pesca del país.

Las evaluaciones efectuadas, sobre la composición de la fauna descartada por las embarcaciones de arrastre, muestra apreciables diferencias entre las regiones de pesca (Tablas 14 a la 16). El contenido de las tablas se estableció sobre la base de las especies cuyo aporte en peso de la captura de fauna descartada representara aproximadamente un 80 %. A pesar de la alta diversidad de especies (60 en las inmediaciones de Margarita – Sucre; 44 en la zona Atlántica y 46 en la plataforma de Unare – Píritu; un reducido número de ellas (6 a 8 especies) representan cerca del 50% del total descartado. La composición íctica de cada región está, seguramente, determinada por diferencias en las cercanías de ambientes lagunares o fluviales al área de pesca, o por el tipo de sustrato y profundidad predominantes. Así se observan especies típicamente oceánicas cercanas a la isla de Margarita o típicamente estuarinas en las muestras del golfo de Paria.

La fauna de descarte estuvo compuesta principalmente por especies de interés comercial en las tres zonas evaluadas del oriente de Venezuela. Las especies con interés comercial representaron el 61% de los descartes cercanos a la isla de Margarita – norte del estado Sucre, 64% en la zona Atlántica y 66% en la plataforma Unare – Píritu. Los tamaños de los ejemplares descartados estuvieron comprendidos en un intervalo de 11 a 52 centímetros longitud total, con un promedio general de 17 centímetros (Tabla 17).

En un esfuerzo por reducir la captura de fauna acompañante del camarón en la pesquería de arrastre, Alió y col. (1995) reportan los resultados del uso de paneles de escape para peces en redes de arrastre industrial en la región oriental de Venezuela. Utilizando paneles cubiertos con malla cuadrada en la parte superior del antecopo de la red, se obtuvo una reducción promedio de 35% sin que se observara una disminución significativa de la captura de camarones. Se obtuvo, adicionalmente, un incremento de 30% en la captura de peces, el cual se supone es debido al aumento en el área barrida por la red con el panel. Motivado a que la biomasa en el copo de la red con panel aumenta a menor velocidad, los portalones permanecen abiertos en mayor proporción que los de la red control. Estos autores obtuvieron una reducción máxima de 51% en los descartes cuando la malla cuadrada del panel era reemplazada por cuerdas que permitían el escape de todos los peces que llegaran al panel; esto también ocasionó pérdidas de 47% en la captura comercial de peces, pero no afectó la de camarones.

El uso obligatorio del TED en las redes de arrastre camaronero desde 1994 perturbó el programa de paneles de escape, aunque han continuado los ensayos para evaluar el uso simultáneo de panel y TED en las redes (Pomares y col. 1997).

**TABLA 13. Composición de los desembarques (por grupo de especies) reportados por la flota de arrastre de la regón oriental de Venezuela durante 1988-99**
**BIOMASA (kg)**

| GRUPO DE ESPECIES | 88 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Camarones | 15170 | 6656 | 24015 | 34679 | 50345 | 2704 | 1313 | 1305 | 1885 | 1306 | 495 |
| By-catch Comercial | 181140 | 52256 | 50626 | 180670 | 600064 | 14747 | 8357 | 5843 | 22110 | 9812 | 9657 |
| By-catch Descartado | 406190 | 158279 | 131480 | 352351 | 592585 | 31550 | 12255 | 15123 | 31029 | 32994 | 18088 |
| TOTAL | 602500 | 217191 | 206121 | 567700 | 1242994 | 49001 | 21925 | 22271 | 55024 | 44112 | 28240 |
| Esfuerzo (h) | 6279 | 1920 | 2086 | 6475 | 13568 | 4677 | 2040 | 2277 | 4595 | 3152 | 2619 |
| | | | | | | | | | | | |
| % Camarones | 3 | 3 | 12 | 6 | 4 | 6 | 6 | 6 | 3 | 3 | 2 |
| % By-catch Comercial | 30 | 24 | 25 | 32 | 48 | 30 | 38 | 26 | 40 | 22 | 34 |
| % By-catch Descartado | 67 | 73 | 64 | 62 | 48 | 64 | 56 | 68 | 56 | 75 | 64 |

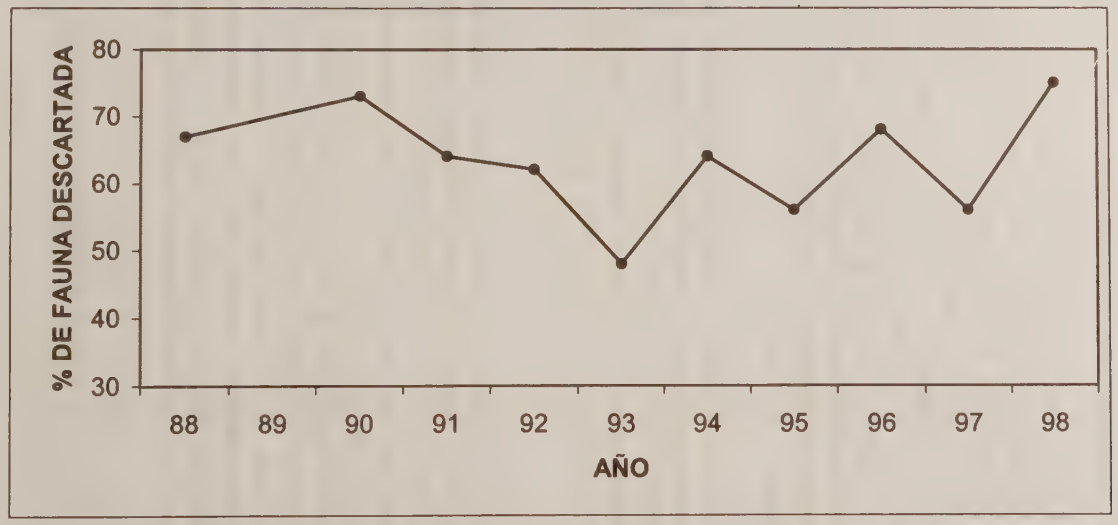



**Fig. 3 Variación en % de la fauna descartada en la pesca de arrastre de la región oriental de Venezuela durante el período 1988-98. Variacion en % de la fauna descartada en la pesca de arrastre de la región oriental de Venezuela, durante 1988-98**

**TABLA 14. Composición de la fauna de descarte en la pesquería de arrastre industrial de camarones al Norte de la Isla de Margarita y Edo. Sucre, región oriental de Venezuela**

| Nombre científico | Familia | Nombre común | % peso |
|---|---|---|---|
| *Scomber japonicus* | Scombridae | Cachorreta | 9.4 |
| *Priacanthus arenatus* | Priacanthidae | Catalana | 9.1 |
| *Synodus foetens* | Synodontidae | Guaripete | 7.3 |
| *Diplectrum formosun* | Serranidae | Yuqueta | 7.2 |
| *Sardinella aurita* | Clupeidae | Sardina | 5.1 |
| *Porichthys sp.* | Batrachoididae | Sapo cadena | 4.4 |
| *Paralichthys tropicus* | Bothidae | Lenguado comun | 4.1 |
| *Prionotus sp.* | Triglidae | Gallineta | 3.7 |
| *Harengula clupeola* | Clupeidae | Carapachona | 3.4 |
| *Trachurus lathami* | Caranguidae | Cataco | 3.4 |
| *Cynoscion jamaicensis* | Sciaenidae | Tonquicha | 3.3 |
| *Cathorops spixii* | Ariidae | Bagre cuinche | 3.2 |
| *Pristipomoides aquilonaris* | Lutjanidae | Panchito | 2.9 |
| *Stellifer spp.* | Scianeidae | Buchichi | 2.9 |
| *Haemulon boschmae* | Haemulidae | Ruyi ruyi | 2.2 |
| *Stomalophus sp.* | Cnidaria - Sciphozoa - Rhizostomae | Agua mala | 2.2 |
| *Scorpaena brasiliensis* | Scorpaenidae | Sapo chasneta | 2.1 |
| *Ortopristis ruber* | Haemulidae | Corocoro | 1.9 |
| *Eugerres plumieri* | Gerreidae | Mojarra | 1.9 |
| *Gymnothorax sp.* | Murraenidae | Morena | 1.9 |
| Otras 43 especies | | | 18.6 |

**TABLA 15. Composición de la fauna de descarte en la pesquería de arrastre industrial de camarones de la región Atlántica de Venezuela**

| Nombre cientifico | Familia | Nombre común | % peso |
|---|---|---|---|
| *Macrodon ancylodon* | Sciaenidae | Curbinata | 13.1 |
| *Genyatremus luteus* | Haemulidae | Torroto | 12.8 |
| *Stomalophus sp.* | Cnidaria - Sciphozoa - Rhizostomae | Agua mala | 6.7 |
| *Nebris microps* | Sciaenidae | Curbinata roja | 6.5 |
| *Porichthys sp.* | Batrachoididae | Sapo cadena | 5.5 |
| *Cathorops spixii* | Ariidae | Bagre cuinche | 4.6 |
| *Haemulon boschmae* | Haemulidae | Ruyi ruyi | 4.3 |
| *Trichopseta caribaea* | Bothidae | Lenguado | 4.3 |
| *Diapterus rhombeus* | Garreidae | Caitipa | 3.7 |
| *Lagocephalus laevigatus* | Tetraodontidae | Futre | 3.6 |
| *Diplectrum formosun* | Serranidae | Yuqueta | 3.5 |
| *Trichiurus lepturus* | Trchiuridae | Tajali | 3.0 |
| *Haemulon steindachneri* | Haemulidae | Cherechere | 2.8 |
| *Larimus breviceps* | Sciaenidae | Bombache | 2.5 |
| *Rhinobatus percellens* | Rhinobatidae | Chola | 2.4 |
| *Harengula clupeola* | Clupeidae | Carapachona | 2.3 |
| Otras 28 especies | | | 18.5 |

**TABLA 16. Composición de la fauna de descarte en la pesquería de arrastre industrial de camarones de la Plataforma Unare - Píritu, zona oriental de Venezuela**

| Nombre cientifico | Familia | Nombre comun | % peso |
|---|---|---|---|
| *Larimus breviceps* | Sciaenidae | Bombache | 20.8 |
| *Menticirrhus americanus* | Sciaenidae | Lambe | 8.3 |
| *Cathorops spixii* | Ariidae | Bagre cuinche | 7.5 |
| *Eugerres* | Gerreidae | Mojarra | 6.7 |
| *Chloroscombrus chrysurus* | Caranguidae | Chicharra | 5.5 |
| *Elops saurus* | Elopidae | Malacho | 4.1 |
| *Synodus foetens* | Synodontidae | Guaripete | 3.8 |
| *Diplectrum formosun* | Serranidae | Yuqueta | 3.5 |
| *Dasyatis spp.* | Dasyatididae | Raya blanca | 3.3 |
| *Symphurus plagusia* | Cynoglossidae | Suela | 3.1 |
| *Bagre bagre* | Siluridae | Bagre bagre | 2.9 |
| *Trichiurus lepturus* | Trichiuridae | Tajali | 2.5 |
| *Polydactilus oligodon* | Polynemidae | Barbulete | 2.2 |
| *Vomer setapinis* | Caranguidae | Lamparosa | 2.2 |
| *Lupella forceps* | Crustacea - Decapoda - Portunidae | Cangrejo | 2.1 |
| *Opisthonema oglinum* | Clupeidae | Machuelo | 2.0 |
| Otras 30 especies | | | 19.5 |

TABLA 17. Talla promedio de las especies componentes de la fauna de descarte en la pequería industrial de arrastre de la región oriental de Venezuela

| Especie | Longitud total promedia (mm) | DE | N | LT Min | LT Max |
|---|---|---|---|---|---|
| Arengula clupeola | 141 | 18 | 146 | 85 | 172 |
| Cathorops spixii | 214 | 79 | 132 | 80 | 420 |
| Diapterus rhombeus | 159 | 20 | 88 | 110 | 220 |
| Diplectrum formosus | 142 | 29 | 662 | 45 | 214 |
| Eugerres plumieri | 141 | 22 | 70 | 103 | 188 |
| Hemulon steindachneri | 144 | 23 | 122 | 100 | 200 |
| Larimus breviceps | 120 | 29 | 108 | 60.0 | 185 |
| Macrodon ancylodon | 237 | 38 | 723 | 105 | 380 |
| Micropogonias furnieri | 190 | 35 | 181 | 102 | 289 |
| Nebris microps | 262 | 64 | 329 | 101 | 510 |
| Orthopristis ruber | 183 | 50 | 873 | 100 | 380 |
| Paralichthys tropicus | 128 | 38 | 108 | 75 | 290 |
| Polydactilus oligodon | 190 | 45 | 8 | 165 | 298 |
| Porichthys sp. | 168 | 41 | 241 | 90 | 320 |
| Priacanthus arenatus | 167 | 56 | 1780 | 14 | 520 |
| Prionotus sp. | 149 | 80 | 28 | 65 | 520 |
| Pristipomoides aquilonaris | 128 | 18 | 285 | 83 | 195 |

## 7. PESQUERÍAS ARTESANALES DE CAMARÓN - PESQUERÍA ARTESANAL DE CAMARONES EN EL LAGO DE MARACAIBO

El golfo de Venezuela y el lago de Maracaibo constituyen las áreas de mayor producción camaronera de Venezuela. Estas dos áreas en conjunto contribuyeron con 4.288 toneladas (98%) a la producción nacional de camarones en el año 1964, con 7.922 toneladas (83%) en 1971 y con 8.118 toneladas (75%) en 1995 (SARPA, 1996).

Las pesquerías artesanales del lago de Maracaibo y bahía del Tablazo tienen una gran importancia social porque generan el 22% del alimento producido en el país, siendo los recursos curvina (*Cynoscion spp.*), lisa (*Mugil spp.*), camarón blanco (*Lithopenaeus schmitti*), cangrejo azul (*Callinectes sapidus*), bagre blanco (*Cathorops spixii*), robalo (*Centropomus* spp.) y carpeta (*Eugerres plumieri*) los de mayor producción. Para el año 1997, la captura de estas especies representó el 70% del total de las capturas artesanales del lago de Maracaibo y bahía del Tablazo, aportando la curvina un 15%, la lisa un 11%, el camarón blanco un 10%, el cangrejo azul un 12%, el bagre blanco un 9%, el robalo un 5% y la carpeta un 8% (FONAIAP, 1998).

Todas estas especies habitan, en las primeras etapas de su vida, en los manglares de la Ciénaga de Los Olivitos y San Carlos. Lamentablemente, la falta de regulaciones pesqueras y las débiles medidas de control y vigilancia permiten que éstas especies sean objeto de una pesca indiscriminada y muchas veces ilegal, al ser capturadas con mallas con aberturas menores de 2,5 pulgadas y en zonas protegidas, como lo es el refugio de fauna silvestre Ciénaga de Los Olivitos. Resulta preocupante que para algunas especies, como el camarón blanco, no exista ninguna reglamentación para su pesca, por lo que, es fuertemente capturado en las zonas de manglar con redes de ¼ de pulgada de abertura de malla, arrastrando junto con él una voluminosa fauna acompañante que es desechada. Esta "basura" la conforman individuos juveniles de curvina, lisa, robalo, bagre, carpeta y cangrejo aún sin valor comercial, así como otras especies propias y necesarias para conservar el equilibrio bioecológico de las zonas manglarinas.

La pesquería de camarones en el occidente de Venezuela, esto es golfo de Venezuela y lago de Maracaibo, es particularmente interesante debido a dos factores que parecen ser propios de la región: 1) La presencia de grandes poblaciones de 4 especies de camarones peneidos en una misma zona, a saber, *Lithopenaeus schmitti*, *Farfantepenaeus subtilis* Ives, *F. notialis* Burkenroad y *F. brasiliensis* Latreille; y 2) La gran abundancia de *L. schmitti* en el área, lo que no ocurre en otras zonas del país ni fuera de Venezuela (Ewald, 1965; Rodríguez, 1980). La gran extensión de aguas estuarinas de baja salinidad parecen reunir las condiciones ecológicas óptimas para el desarrollo del camarón blanco (Pérez-

Farfante, 1970). Este es capturado y desembarcado entero en las playas de las costas nortoccidental y nororiental del lago de Maracaibo y en la bahía del Tablazo.

La pesquería artesanal de camarón en la región del lago de Maracaibo está fundamentada en el camarón blanco (*F.* schmitti), que al igual que el resto de las especies de la familia Penaeidae, se distingue por la corta duración de su ciclo de vida (del orden de los dos años), y su presencia en cantidades significativas en la pesquería durante un período generalmente poco superior al año. Otra característica esencial es la existencia de un ciclo vital anfibiótico, el cual incluye una fase juvenil muy costera o estuarina, explotada por la pesca artesanal del lago de Maracaibo, y una fase adulta en aguas más profundas, explotada por la pesca industrial del golfo de Venezuela (Ewald, 1965; Cadima *et al.*, 1972; García y Le Reste, 1986).

El camarón blanco representa cerca del 55% de las capturas comerciales de camarones del golfo de Venezuela y cerca del 90% de las capturas de camarones del lago de Maracaibo (Andrade, 1991). De la producción total de esta especie, en el occidente del país el 46% se captura en el lago de Maracaibo. Este es uno de los recursos pesqueros de mayor valor monetario en Venezuela y una importante fuente de divisas ya que el 98% de la producción del lago de Maracaibo se exporta, alcanzando los 18 millones de dólares americanos en el año 1998 (Aduana Principal de Maracaibo, 1998).

En los últimos años, la pesca de camarones en las zonas de los manglares de la Ciénaga de Los Olivitos y San Carlos se ha intensificado debido a la disminución de los efectivos pesqueros en las áreas tradicionales de captura, ocasionando que, con más frecuencia, los pescadores se desplacen hacia estas zonas manglarinas para asegurar sus ingresos. Aparentemente se captura camarón clasificado como pequeño, y por lo que no es bien pagado, pero los volúmenes de captura parecen ser tan altos que compensan los costos de extracción.

Con la finalidad de conservar y proteger las especies que son el soporte de la pesquería artesanal del lago de Maracaibo y bahía del Tablazo, es necesario conocer la composición y abundancia de las especies que son arrastradas junto con el camarón capturado en las zonas manglarinas de la región. En evaluaciones preliminares se observó entre la fauna acompañante del camarón a especies como: curvina, lisa, bagre blanco, robalo y carpeta. De esta lista, la curvina se considera sobre-explotada y otras están en vías de sobreexplotación, como son la lisa, el robalo y la carpeta.

**Artes y métodos de pesca del camarón blanco en el lago de Maracaibo**

Las capturas de camarones en el lago de Maracaibo se realizan generalmente desde embarcaciones tipo bote, llamadas chalanas, construidas de madera, y cuyas dimensiones varían entre 8 a 10 metros de eslora, de 1,0 a 1,5 metros de manga y de 0,8 a 1,0 metros de puntal. Estas embarcaciones son propulsadas por un motor fuera de borda, generalmente de 35 a 40 caballos de fuerza (HP).

Cada embarcación camaronera utiliza una red llamada comúnmente mandinga. Esta red se cala desde el bote formando un semicírculo y es guiada dentro del agua por 3 pescadores. Una vez rodeada la agregación de camarones, otros 2 pescadores que se encuentran dentro del bote, recuperan la red y depositan la pesca a bordo ( la mandinga tiene generalmente 150 metros de largo, 5 metros de altura y una abertura de malla (entre nudos) de 0,25 a 1 pulgada. La mandinga es el arte de pesca predominante en el lago de Maracaibo y bahía del Tablazo, por lo que, la casi totalidad de las capturas de camarones en dichas áreas es realizada con este arte. En algunos sitios donde el arrastre no se puede realizar, como en las zonas de manglar y en los canales de los estuarios, se utiliza una atarraya. Este tipo de red es maniobrada por un sólo pescador, teniendo la misma de 2 a 3 metros de largo, 3 a 4 metros de ancho y también de 0,25 a 1 pulgada de abertura de malla.

Existe una modalidad de pesca de camarones poco frecuente y que no necesita embarcación. Esta faena se realiza con una mandinga o chinchorro playero, el cual se cala hacia afuera desde la playa formando un semicírculo. Uno de los extremos se deja fijo, por medio de un pescador en la playa, y el otro extremo que queda suelto es conducido por 2 o 3 pescadores, de suerte que encierre la agregación de camarones que es luego traída a la playa al recoger la red.

En la zona sur del lago de Maracaibo todavía se pescan camarones con pequeñas embarcaciones sin motor (cayucos), que miden entre 5 a 6 metros de largo, las cuales son operadas por 2 a 3 hombres, utilizando para la captura un red denominada "copito".

La faena de pesca se realiza todos los días del año, excepto el día de Navidad y Año Nuevo. Ordinariamente, esta comienza en la noche cerca de las 9:00 p.m. y termina alrededor de las 4:00 a.m., pudiéndose prolongar hasta las 8:00 a.m., dependiendo de la captura y de la hora de salida.

Las principales áreas de pesca de camarón en la bahía del Tablazo, zona norte del lago de Maracaibo, son los alrededores de las islas San Carlos, Zapara, Pájaros, Toas, y los manglares de la pequeña bahía de Java. Los camarones capturados en estas zonas son desembarcados casi en su totalidad en el puerto de El Moján, ubicado en el municipio San Rafael del Moján.

En el estrecho del lago de Maracaibo, en la costa oriental, se encuentra el puerto de La Rita, en donde son desembarcados los camarones provenientes de los alrededores de Santa Rita, Puerto Escondido, El Mene y Cabimas. En la costa occidental del lago de Maracaibo se encuentra el puerto de Curarire; a éste llegan los camarones capturados en las inmediaciones de Palmarejo, Potreritos, Curarire, desembocadura del río Palmar, Majagual, Don Alonso y Barranquitas. En este último sitio también se encuentra un puerto de desembarque donde eventualmente se descargan camarones.

El camarón es vendido "en puerto", generalmente después de haber sido clasificado como camarón grande y camarón pequeño, dependiendo su precio del tamaño. Actualmente el precio por kilogramo del camarón pequeño oscila entre 1.500 a 2.000 bolívares (2,25 y 2,94 dólares americanos) y el precio por kilogramo del camarón grande entre 2.500 a 3.000 bolívares (3,68 y 4,41 dólares americanos).

**Producción Artesanal**

Las capturas mensuales de camarones, desembarcados en el puerto de Curarire, desde julio de 1991 hasta diciembre de 1993, indicaron que los mayores valores se presentan en los meses de abril, julio y noviembre. Durante estos meses, las capturas por unidad de esfuerzo alcanzaron diariamente un promedio de 22 kilogramos por embarcación$^{-1}$. El desembarque mensual de camarones para el año 1993 fue extraordinariamente alto, principalmente entre agosto y diciembre, alcanzando un valor máximo de cpue de 65,8 kilogramos por embarcación$^{-1}$ y un valor promedio de 29,6 kilogramos por embarcación$^{-1}$.

Con respecto a los desembarques promedio por mes de camarón grande y pequeño, durante el mismo período de estudio, pudimos observar que los mayores volúmenes de camarón grande ocurrieron, generalmente entre los meses de julio y diciembre, mientras que los camarones pequeños alcanzaron, generalmente grandes cantidades entre los meses de marzo a mayo y de agosto a octubre. Sin embargo, el año 1993 puede considerarse excepcional, ya que, durante los meses de noviembre y diciembre hubo más capturas de camarón pequeño que grande (1,9 y 5,9 veces respectivamente).

La producción de camarones en el lago de Maracaibo durante los últimos 6 años presenta una tendencia a la disminución, según cifras obtenidas del SARPA-Occidente (Tabla 18).

**Especies acompañantes del camarón blanco**

En un muestreo preliminar realizado en Ancón de Iturre, costa oriental de la bahía del Tablazo, Municipio Miranda, se obtuvieron las siguientes especies acompañantes de las capturas de camarones, para la cual se utilizaron redes de ¼ de pulgada de abertura de malla. Las especies en estado juvenil identificadas fueron *Elops saurus* (macabí), *Eugerres plumieri* (carpeta), *Anchovia clupeoides* (sardina), *Diapterus rhombeus* (carpeta), *Centropomus paralelus* y *C. ensiferus* (robalo), *Oligoplites palometa* (palometa), *Anchoa lamprotaenia* (sardinita), *Achirus lineatus* (lenguado), *Arius herzbergii* (bagre guatero), *Spheroides testudineus* (sapito), *Citharichtys spilopterus* (lenguado) y *Mugil curema* (lisa), entre los crustáceos tenemos *Callinectes sapidus* y *C. boucorti* (cangrejo).

Uno de los objetivos del proyecto, cofinanciado por FAO, es cuantificar y evaluar la fauna de acompañamiento del camarón en esta pesquería y medir el impacto de la misma sobre las poblaciones ícticas de la región del lago de Maracaibo.

**TABLA 18. Producción de camarones del lago de Maracaibo**

| AÑO | PRODUCCIÓN (TM) | NUMERO EMBARCACIONES |
|---|---|---|
| 1993 | 5482 | 557 |
| 1994 | 3358 | 634 |
| 1995 | 3157 | 625 |
| 1996 | 2324 | 1091 |
| 1997 | 3586 | 682 |
| 1998 | 2103 | 743 |

Fuente: SARPA Occidente

## 8. PESCA ARTESANAL DE CAMARONES EN LA DESEMBOCADURA DEL CAÑO MÁNAMO Y ÁREAS ADYACENTES

La pesca artesanal comercial en la desembocadura del caño Mánamo y áreas adyacentes tiene una tradición cercana a 40 años o más, pues la pesca de subsistencia data del período precolombino. Los pescadores indígenas, bajo la influencia y organización de pescadores margariteños, han venido operando comercialmente y destinando la producción a las estaciones de pesca que se han organizado desde hace tiempo en Pedernales y otras localidades de cierta importancia en esta parte del delta costero o bien, intercambiando el pescado por artículos diversos con comerciantes de Irapa, Güiria, entre otros.

Tradicionalmente, la pesca en la zona estuvo orientada a la captura de especies de peces empleando la red de ahorque o agallera, así como los artes de anzuelo, tales como el palangre y la línea o cordel. El producto de la pesca, inicialmente salado y luego mayoritariamente fresco, se destina a Güiria, Irapa o Maturín, mercados tradicionales del pescado acopiado en Pedernales. Entre las especies comerciales de mayor importancia se destacan los bagres marinos, la lisa y el lebranche, curvinas y curvinatas, robalos, cazones y rayas.

La pesca comercial se consolidó con diversas empresas o estaciones de pesca que organizaban la captura, el acopio y la comercialización del producto, alcanzando cifras de capturas anuales de cierta importancia para la década de los 80. Aunque las cifras oficiales siempre fueron algo irregulares, los estimados de producción de pescado en esta parte del bajo delta oscilaron entre las 1.000 y 3.500 toneladas métricas al año.

A partir de 1993, se estableció y consolidó la pesquería de arrastre camaronero empleando el modelo trinitario basado en el uso de peñeros y redes de arrastre operadas manualmente. El objeto de captura es el camarón que se distribuye y es muy abundante en los ecosistemas deltaicos, con bahías semicerradas y abundantes recursos alimenticios para numerosas especies. La pesquería de arrastre en esos sistemas costeros es muy impactante por cuanto afecta una comunidad biológica rica y diversa que, en el caso de la desembocadura del caño Mánamo, está compuesta por unas 80 especies de peces y algunos macroinvertebrados. La mayoría de tales especies utilizan las desembocaduras de los caños como lugares donde transcurren las primeras fases del desarrollo y constituyen las zonas de crecimiento de dichas especies.

Durante el bienio 1980-1981, en la desembocadura del caño Mánamo y sus alrededores se efectuaron intensos muestreos de la fauna acuática empleando tanto redes de ahorque como de arrastre camaronero, de forma tal que se tiene un inventario completo de la composición de la comunidad de peces y de macro invertebrados presentes en aquél entonces. También se establecieron indicadores de niveles de abundancia, estacionalidad, así como algunos parámetros biológicos. (Cervigón, 1982; Novoa,1982; Novoa *et al.* 1982; Ramos *et al.* 1982; Novoa y Cervigón, 1986).

Es bien conocido el efecto de "simplificación" de la fauna acuática que produce la pesca de arrastre en los ecosistemas marinos, tal como ha sido reportado por diversos autores en distintas áreas (Pauly, 1983; Novoa *et al.* 1980). Tal efecto se potencia aún más en los ecosistemas costeros por la eliminación de grandes cantidades de peces jóvenes y adultos, habituales depredadores de los camarones y cangrejos, los cuales al ser reducidos sus enemigos naturales, aumentan a mediano plazo sus niveles de

abundancia. Las especies de peces son muy afectadas, pues al eliminar grandes cantidades de jóvenes en las áreas de crecimiento, sólo llega a la etapa adulta un número reducido de ejemplares. Las pesquerías que dependen de las fases adultas de estas especies también se ven perjudicadas.

Con el objeto de evaluar el impacto que la pesquería de arrastre artesanal ha tenido sobre la comunidad de peces e invertebrados del área, en 1998 se realizó un programa de pesca exploratoria, a fin de determinar los cambios más notorios que hayan podido presentarse en los índices de abundancia y en la estructura o composición de la fauna acuática en la desembocadura del caño Mánamo y sus alrededores.

**Trabajo realizado:** En los meses de enero, marzo, junio y septiembre de 1998, se realizaron visitas de campo tomando a Pedernales como centro de operaciones, debido a que en esa localidad se concentra la flota que explota al camarón artesanalmente.

Durante la realización de las pescas exploratorias, y en cada lance o calada, se tomaron datos de la fecha, localidad, tiempo de pesca, estado de la marea, salinidad y posición exacta del sitio de muestreo empleando para ello un posicionador satelital (GPS).

Para la pesca exploratoria de arrastre se empleó una red tipo camaronero, de las utilizadas tradicionalmente por los pescadores trinitarios y construidas en ese país. En cada campaña se efectuó un número variable de caladas ó lances, de 30 a 60 minutos de duración cada uno, clasificando la captura de acuerdo a las especies colectadas. En general, la totalidad de la captura fue preservada en hielo para realizar su identificación y muestreo biológico.

Los datos de longitudes de las distintas especies fueron agrupados, procesados y se elaboraron los histogramas de las distribuciones de las frecuencias de tallas.

## Resultados

### *Estadísticas*

En Pedernales existía una inspectoría de pesca en donde se controlaban las actividades pesqueras que se desarrollaban en las inmediaciones de ese puerto. Desde hace algunos años, dicho control se hace desde Güiria con las deficiencias que son de esperar.

Las cifras cuantitativas de los desembarques anuales posiblemente tengan sólo una utilidad referencial. No obstante, cualitativamente pueden ser de mayor utilidad para analizar los cambios que se han producido en los últimos años con respecto al valor relativo de las especies comerciales más comunes en los desembarques anuales.

**TABLA 19. Desembarques totales y de camarones reportados en Pedernales**

| *AÑO* | *CAPTURA (TM)* | |
|---|---|---|
| | **Totales** | **Camarones** |
| 1981 | 3.158 | - |
| 1982 | 1.834 | 12 |
| 1983 | 5.555 | - |
| 1984 | 3.197 | - |
| 1985 | 1.247 | - |
| 1990 | 1.574 | 3 |
| 1991 | 1.566 | 5 |
| 1992 | 1.635 | 31 |
| 1993 | 1.157 | 144 |
| 1994 | 1.178 | 143 |
| 1995 | 992 | 236 |

Fuente: MAC-SARPA, 1996

Como se puede deducir, pareciera que en la década de los 80 los desembarques totales fueron de mayor importancia, en cuanto al peso, que los correspondientes a los años más recientes. En 1993 se acentuó

la disminución de los desembarques totales respecto a los obtenidos en años precedentes, lo cual coincide con el aumento de los desembarques de camarón registrados en ese puerto (Tabla 19). Al parecer, debido a que el camarón tiene un altísimo valor en los mercados de exportación, se ha venido produciendo un cambio progresivo de objeto de las pesquerías cuyo foco es ahora el camarón. Esta pesquería de alto valor, es de bajos rendimientos en comparación con la de peces y eso, posiblemente, ha provocado la caída observada en los desembarques totales.

**Síntesis de la pesquería de arrastre costera de camarón**

A continuación, se ofrece una descripción sucinta de la pesquería de arrastre de camarones en los alrededores de Pedernales.

- Número de unidades de pesca = 28 (Pedernales) + 6 ( isla Misteriosa) = 33.
- Características estructurales de las unidades = Eslora promedio: 9 metros; Manga: promedio 3 metros; Puntal: promedio 1,6 metros.
- Arte de pesca = Red de arrastre artesanal, de poliamida (Nylon), con una abertura de malla de 3,5 centímetros en el cuerpo y 2,5 centímetros en el copo.
- Áreas de pesca = Inmediaciones de Pedernales, isla Cotorra, Bajo del Medio y las isletas, cerca de la desembocadura del caño Mánamo.
- Tiempo de pesca por viaje = Los viajes son diarios y las embarcaciones faenan durante unas 4 horas con luz diurna y durante la marea vaciante.
- Número de viajes mensuales por embarcación = 15 - 20.
- Captura promedio por viaje = En 1995 se obtuvo un promedio de 30 kilogramos de camarones por viaje, con máximos entre diciembre y abril. Hay una captura incidental de peces y camarones pequeños que se desecha al agua; los de mayor tamaño son consumidos por los tripulantes de las embarcaciones. Los datos obtenidos en los primeros meses de 1998, confirman unos rendimientos algo superiores a los 30 kilogramos diarios por embarcación.
- Especies comerciales más importantes: Camarón blanco (*Lithopenaeus schmitti*) el cual predomina y el camarón marrón *(Farfantepenaeus subtilis*). Ocasionalmente son capturados ejemplares del camarón de río, *Macrobrachium* spp.
- Régimen de pesca: Todo el año.
- Desembarques anuales estimados: 300 toneladas (1997).
- Estructura de la producción: pescadores individuales con apoyo financiero de dueños de estaciones pesqueras.
- Comentario: Se trata de una pesquería en desarrollo, de una alta rentabilidad debido al elevado valor del camarón, cuya captura es el objetivo fundamental de este sistema de producción. Se inició en 1993 y desde entonces se ha triplicado, tanto en las capturas como en el esfuerzo de pesca. Se estima que puede expandirse aun más aunque hay que revisar sus efectos al resto de la fauna acuática.

***Pesca exploratoria con red de arrastre camaronera. Resultados del muestreo***

Empleando embarcaciones de la flota camaronera de Pedernales, se trabajó en las mismas áreas de pesca que utiliza dicha flota frecuentemente. Destacan los alrededores de isla Cotorra, el Pajar; boca del caño Venado y laguna del Medio.

La fauna marina predominó durante todo el muestreo especialmente el camarón blanco, seguido por los bagres marinos, especialmente el bagre cuinche.

Cuando se comparan las tendencias históricas de los distintos grupos de la fauna acuática, se pueden deducir algunos aspectos de interés.

En cuanto a diversidad específica, en los primeros años de estudio se lograron identificar unas 78 especies en el área de Pedernales y sus alrededores, incluyendo todas las artes en operación durante las colectas. Un número similar fue recolectado en los muestreos de 1988.

**TABLA 20. Capturas (kilogramos) resultantes de la pesca experimental de arrastre camaronero, para cada una de las salidas de campo efectuadas en las inmediaciones de Pedernales, delta del río Orinoco, así como los totales para todo el período de muestreo abarcado en este estudio**

| ESPECIES | ENE. | MAR. | JUN. | SEP. | TOTAL | % |
|---|---|---|---|---|---|---|
| *Dasyatis guttata* | 11,6 | 10 | | 4,5 | 26,1 | 4,853 |
| *Himantura schmardae* | | | | 7,8 | 7,8 | 1,450 |
| *Triportheus* sp | | | | 0,1 | 0,1 | 0,019 |
| *Anchoa spinifer* | | | 0,55 | 0,15 | 0,7 | 0,130 |
| *Rhinosardina amazonica* | | 0,125 | 0,1 | 0,13 | 0,36 | 0,067 |
| *Pellona flavipinnis* | | 0,15 | 0,3 | 0,94 | 1,39 | 0,258 |
| *Odontognathus mucronatus* | | 1,05 | 0,49 | 0,84 | 2,38 | 0,442 |
| *Lycengraulis grossidens* | | | 0,8 | | 0,8 | 0,149 |
| *Cetengraulis edentatus* | | 4,81 | 1,07 | 1,35 | 7,23 | 1,344 |
| *Pterengraulis atherinoides* | | | 0,32 | 0,54 | 0,86 | 0,160 |
| *Cathorops spixii* | 15 | 31,9 | 35,6 | 15,7 | 98,2 | 18,258 |
| *Arius rugispinnis* | 14,2 | 0,4 | 2,3 | | 16,9 | 3,142 |
| *Arius herzbergii* | | | 0,25 | 2,43 | 2,7 | 0,502 |
| *Arius couma* | 12,6 | 4,3 | 0,25 | 0,6 | 17,8 | 3,309 |
| *Pimelodus* sp | | | 0,1 | | 0,1 | 0,019 |
| *Bagre bagre* | 5,5 | 0,1 | 0,77 | 0,32 | 6,7 | 1,246 |
| *Brachyplatystoma vaillantii* | | | 0,4 | 0,06 | 0,46 | 0,086 |
| *Hypophtalmus edentatus* | | | 0,3 | 0,64 | 0,94 | 0,175 |
| *Pseudoauchenipterus nodosus* | 2,1 | 0,3 | 0,89 | 0,67 | 3,96 | 0,736 |
| *Cynoscion acoupa* | 2,45 | 0,37 | 0,3 | 0,49 | 3,6 | 0,669 |
| *Nebris microps* | | 1,05 | 0,25 | 0,2 | 1,95 | 0,363 |
| *Macrodon ancylodon* | | 2,98 | 5 | 0,28 | 8,26 | 1,536 |
| *Stellifer rastrifer* | 6,55 | 2,95 | 9 | 3,6 | 22,1 | 4,109 |
| *Stellifer microps* | 6,75 | 3,05 | 5,14 | 2,98 | 17,92 | 3,332 |
| *Plagioscion* sp | | | 0,12 | | 0,12 | 0,022 |
| *Pristobrycon* sp | | | | 0,01 | 0,01 | 0,002 |
| *Bairdella ronchus* | | | | 0,05 | 0,05 | 0,009 |
| *Micropogonias furnieri* | | 1,03 | 0,17 | 0,29 | 1,49 | 0,277 |
| *Polidactilus virginicus* | | 0,1 | 0,54 | | 0,64 | 0,119 |
| *Oligoplistes palometa* | | 1,32 | 0,11 | 0,12 | 1,55 | 0,288 |
| *Selene setapinnis* | | 0,55 | 0,46 | | 1,01 | 0,188 |
| *Selene vomer* | | 0,33 | | | 0,33 | 0,061 |
| *Caranx hippos* | | | 0,2 | 0,45 | 0,65 | 0,121 |
| *Hemicaranx* sp | | 0,16 | 0,07 | | 0,23 | 0,043 |
| *Mugil* sp | | 0,05 | | 0,15 | 0,2 | 0,037 |
| *Trachinotus cayenensis* | | 1,96 | 1,9 | 0,02 | 3,88 | 0,721 |
| *Trachinotus corillinus* | | | 0,2 | | 0,2 | 0,037 |
| *Diapterus rhombeus* | | 0,67 | 0,12 | 0,45 | 1,24 | 0,231 |
| *Chaetodipterus faber* | | 0,45 | 0,08 | 0,03 | 0,56 | 0,104 |
| *Genyatremus luteus* | 0,3 | 1,23 | 0,29 | 0,66 | 2,48 | 0,461 |
| *Trichurus lepturus* | 1,75 | 4,95 | 3,83 | 0,2 | 10,73 | 1,995 |
| *Centropomus* sp | | 0,1 | 0,1 | 0,22 | 0,42 | 0,078 |
| *Epinephelus itajara* | 0,15 | | | | 0,15 | 0,028 |
| *Achirus achirus* | 12,5 | 13,1 | 6,6 | 10,9 | 43,1 | 8,013 |
| Lenguados no id. | | 1,33 | | | 1,33 | 0,247 |
| Engraulido no id. | | 0,97 | | 0,09 | 1,06 | 0,197 |

| ESPECIES | ENE. | MAR. | JUN. | SEP. | TOTAL | % |
|---|---|---|---|---|---|---|
| *Aspredinichthys tibicens* | 0,29 | | 0,12 | | 0,41 | 0,076 |
| *Aspredo aspredo* | 0,6 | | 1,95 | 0,11 | 2,66 | 0,495 |
| *Colomesus psittacus* | 8,7 | 9,4 | 0,2 | 6,46 | 24,76 | 4,603 |
| *Spheroides testudineus* | 6,9 | 5,5 | | 0,91 | 13,31 | 2,475 |
| *Batrochoides surinamensis* | 0,1 | 0,2 | 1,3 | 0,68 | 2,28 | 0,424 |
| *Pimelodus* sp | 0,2 | | | | 0,2 | |
| *Gobionellus hastatus* | | 0,18 | 0,16 | | 0,34 | 0,063 |
| *Lithopenaeus schmitti* | 41,3 | 20,35 | 18,75 | 83,21 | 163,61 | 30,419 |
| *Farfantepenaeus subtilis* | | | | | | |
| *Xiphopenaeus kroyerii* | | 0,03 | 0,53 | | 0,56 | 0,104 |
| *Macrobrachium amazonicum* | | | | | | |
| *Macrobrachium rosenbergii* | | | 0,15 | | | 0,15 |
| *Callinectes bocourti* | 0,9 | 1,3 | 3,55 | 1,01 | 6,76 | 1,257 |
| Moluscos no ident. | | 1,52 | 0,89 | 0,02 | 2,43 | 0,452 |
| TOTAL | 150,39 | 130,32 | 106,4 | 149,8 | 536,91 | 100,000 |
| número de horas pesca | 5 | 8,12 | 5,02 | 6,63 | 24,77 | |

Nota: El peso indicado para *Lithopenaeus schmitti* incluye un 1% correspondiente al *F. subtilis*.

**TABLA 21. Análisis comparativo entre los muestreos de la fauna de fondo efectuados en 1980-1981, 1988 y 1998**

| AÑOS | 1981 | | 1988 | | 1998 | |
|---|---|---|---|---|---|---|
| | % | KG/H | % | KG/H | % | KG/H |
| Dasyatidae (rayas) | 16,0 | 9,38 | 21,6 | 6,91 | 6,32 | 1,37 |
| Ariidae (bagres marinos) | 34,8 | 19,88 | 42,50 | 14,49 | 26,52 | 12,5 |
| Scienidae (curvinas curvinata) | 14,4 | 8,47 | 9,0 | 2,96 | 10,35 | 2,24 |
| Soleidae (lenguados) | 3,4 | 2,01 | 4,1 | 1,3 | 8,03 | 1,74 |
| Batrachoididae (sapo) | 5 | 2,95 | 0,8 | 0,27 | 0,42 | 0,09 |
| Tetraodontidae (tamborines) | 0,18 | 0,1 | 2,2 | 0,69 | 7,1 | 1,54 |
| Engraulidae + Clupeidae | 0,81 | 0,48 | 0,4 | 0,13 | 2,3 | 0,51 |
| Penaeidae (camarones) | 22,3 | 13,1 | 14,63 | 4,67 | 30,6 | 6,62 |
| TOTAL | - | 58,8 | - | 32 | - | 21,7 |

Fuentes: Novoa (1982); Novoa ( 1995)

En el presente muestreo se han logrado identificar un total de 73 especies de peces y macroinvertebrados, 60 de ellas capturadas con la red de arrastre, 5 adicionales en las redes de ahorque que no aparecieron en los arrastres y 8 observadas en los desembarques comerciales, que no fueron recolectadas en los muestreos. Ese número de especies de la fauna acuática es similar al reportado por Novoa y Cervigón (1982), por lo cual, se puede afirmar que la diversidad específica en el área estudiada no ha sufrido modificaciones substanciales. Sin embargo, cambios muy marcados se presentan en los niveles de abundancia de la biomasa total y de algunas especies a lo largo de período 1980-1998.

**Aspectos generales de la biología de los recursos pesqueros de la desembocadura del caño Mánamo**

***Composición por talla de los camarones y otras especies de peces***

Para analizar la composición por largos del camarón blanco (*Lithopenaeus schmitti*) en el área, se determinó la distribución relativa de frecuencias de talla de esa especie entre los meses de enero y noviembre de 1998.

**TABLA 22. Distribución de frecuencias de talla para el camarón blanco en la desembocadura C. Mánamo durante el período de enero - noviembre de 1998**

| Longitud total (cm) | | Enero | | Marzo | | Junio | | Septiembre | | Noviembre | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Intervalo | Clase | # | % | # | % | # | % | # | % | # | % |
| 5.6 – 6.5 | 6 | 1 | 1,0 | | 0,0 | | | | | | |
| 6.6 – 7.5 | 7 | 3 | 2,9 | | 0,0 | 4 | 2,9 | | 0,0 | | 0,0 |
| 7.6 – 8.5 | 8 | 10 | 9,5 | | 0,0 | 7 | 5,1 | 4 | 5,4 | | 0,0 |
| 8.6 – 9.5 | 9 | 17 | 16,2 | 2 | 1,9 | 7 | 5,1 | 11 | 14,9 | | 0,0 |
| 9.6 – 10.5 | 10 | 10 | 9,5 | 10 | 9,7 | 18 | 13,1 | 20 | 27,0 | | 0,0 |
| 10.6 - 11.5 | 11 | 11 | 10,5 | 17 | 16,5 | 28 | 20,4 | 13 | 17,6 | 1 | 2,0 |
| 11.6 - 12.5 | 12 | 15 | 14,3 | 12 | 11,7 | 20 | 14,6 | 16 | 21,6 | 16 | 31,4 |
| 12.6 - 13.5 | 13 | 17 | 16,2 | 11 | 10,7 | 20 | 14,6 | 6 | 8,1 | 19 | 37,3 |
| 13.6 - 14.5 | 14 | 9 | 8,6 | 19 | 18,4 | 19 | 13,9 | 4 | 5,4 | 8 | 15,7 |
| 14.6 - 15.5 | 15 | 7 | 6,7 | 15 | 14,6 | 10 | 7,3 | | 0,0 | 3 | 5,9 |
| 15.6 - 16.5 | 16 | 3 | 2,9 | 12 | 11,7 | 3 | 2,2 | | 0,0 | 4 | 7,8 |
| 16.6 - 17.5 | 17 | 1 | 1,0 | 2 | 1,9 | 1 | 0,7 | | 0,0 | | 0,0 |
| 17.6 - 18.5 | 18 | 1 | 1,0 | 2 | 1,9 | | 0,0 | | 0,0 | | 0,0 |
| 18.6 - 19.5 | 19 | | 0,0 | 1 | 1,0 | | 0,0 | | 0,0 | | 0,0 |
| **Total ejemplares** | | **105** | | **103** | | **137** | | **74** | | **51** | |

Se puede constatar que durante algunos meses hay un mayor porcentaje de individuos de las menores tallas (septiembre, enero), así como en otros meses hay porcentajes más elevados de individuos de las tallas mayores (marzo). Arbitrariamente, se definió como 13,5 centímetros la talla donde la totalidad de los ejemplares de camarón blanco han pasado al mar, se han reclutado a la pesquería oceánica de ese recurso. Este proceso es muy importante por cuanto está asociado a la reproducción del camarón.

Durante el mes de marzo se encontró el mayor porcentaje de "reclutas" del período, mientras que en septiembre este porcentaje fue el menor (Fig. 4). Tales resultados se corresponden bien con los encontrados por Novoa (1982), quién registró que la época de mayor presencia de "reclutas" en el área se presentó entre los meses de febrero y mayo.

Si bien el patrón anual de reclutamiento, anteriormente descrito, parece ser más o menos constante, es muy probable que se registren variaciones importantes en la magnitud del reclutamiento interanual, de un año a otro, inducidas por parámetros climáticos. Los datos de la empresa venezolana que operó en el área, parecen confirmar tales variaciones interanuales en la intensidad o magnitud del reclutamiento del camarón blanco (*Lithopenaeus schmitti*) en la bahía de Pedernales para 1993 - 1995.

Un cuidadoso monitoreo de factores ambientales, tales como la intensidad de lluvias o la descarga anual de los caños, podría contribuir significativamente a mejorar la gestión o manejo pesquero del recurso camarón en el delta costero.

## 9. ENSAYOS PARA REDUCIR LA CAPTURA DE PECES EN REDES ARTESANALES DE ARRASTRE

Durante las operaciones artesanales de arrastre camaronero se capturan una cantidad considerable de peces, muchos de ellos juveniles de especies de interés comercial que desovan cerca de la costa. En esta pesquería solamente el camarón tiene valor comercial, por lo que, todos los peces son descartados o consumidos; los de mayor tamaño por los tripulantes de las embarcaciones.

Para intentar reducir la captura incidental de peces se ensayaron dos tipos de métodos de escape para peces. Altuve y col. (1998) describen el uso de un panel de escape construido con malla cuadrada en el antecopo de la red. El mismo permitía el escape de los ejemplares de menor tamaño, reteniendo las especies que eventualmente pudieran tener algún uso comercial. La captura de peces en la red con el

panel de escape alcanzó un 60% del total, comparado con un 75% en la red control; la de peces sin interés comercial fue de 48% en la red con el panel a 69% en la red control. Las reducciones observadas en este caso fueron más modestas que las reportadas por Alió y col. (1995) para los ensayos en barcos industriales de arrastre. Se estima que las diferencias puedan ser atribuidas a que el escape con el panel de malla cuadrada requiere una detección activa de la salida por los peces, cosa que es más difícil en las aguas altamente turbias del río Orinoco.

Posteriormente se realizó un ensayo con un panel tipo rejilla (Nordmore), que condujera hacia la salida a todos los peces que llegaran hasta ella y que no fueran menores que la separación entre las barras (2 centímetros). En ambientes con alto contenido de hojas y ramas, como es el caso de la desembocadura del río Orinoco, este tipo de rejilla es muy susceptible a la obstrucción. En momentos en que la corriente de descarga era leve, la rejilla funcionó bien, logrando una reducción total de los peces mayores a 2 centímetros de diámetro. Cuando la corriente aumentó, el exceso de hojas en la captura bloqueó la rejilla completamente. Se estima que este implemento pudiera funcionar bien en ambientes costeros más alejados de la boca de los ríos.

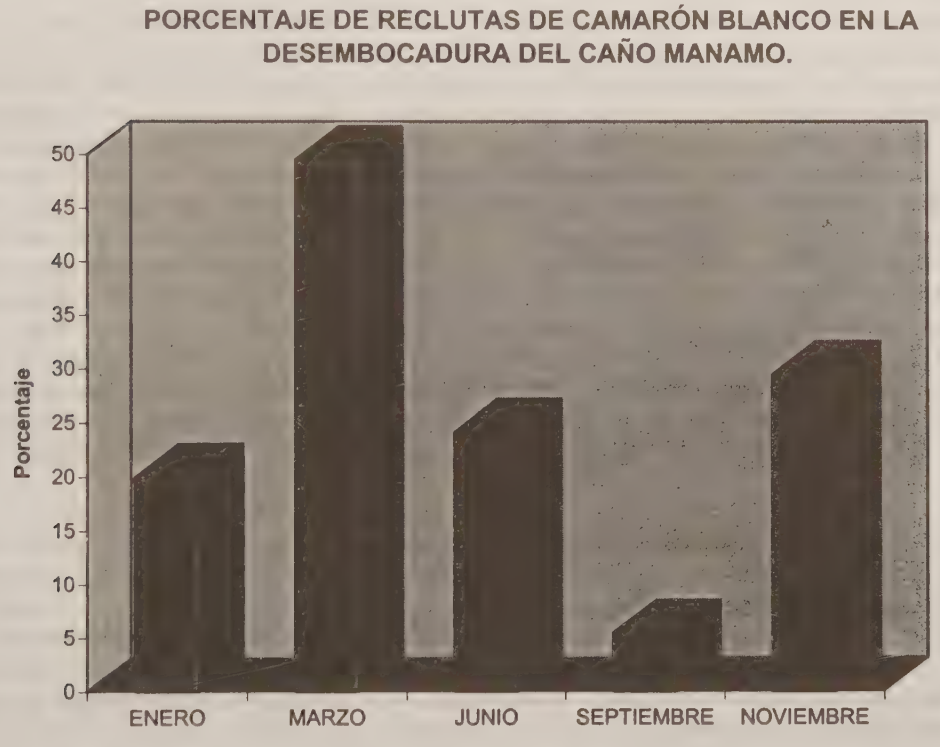



**Figure 4. Variaciones porcentuales de la fracción de "reclutas" a lo largo del período de estudio, considerando la suma de los individuos con tallas superiores a 13,5 cm**

## 10. TECNOLOGÍA PESQUERA EN USO

### Tipos de redes en barcos camaroneros

Las embarcaciones están equipadas para trabajar al estilo florida de arrastre (con dos redes por las bandas) y utilizan un "winche" hidráulico con dos tambores. Cada tambor lleva de 500 a 600 metros de guaya de acero, con diámetro de 50,8 – 63,5 milímetros. La longitud del cable limita las operaciones a fondos no más profundos de 70 metros. El cable está marcado en cada braza para conocer la cantidad de cable largado.

Los portalones son rectangulares, de 2,45 x 1,0 metros ó 2,70 x 1,10 metros, hechos con madera y zapatas y hombros de hierro. Las patas de gallo están hechas con cadenas, teniendo la frontal

0,8 metros y la posterior 1,35 metros. La conexión a la relinga de flotadores es de polipropileno, de 2-2,5 metros de longitud, mientras que la que va del portalón a la relinga de plomos está hecha con cadenas y mide 2,9 metros. Las tijeras son de guaya de 12,7 milímetros de diámetro y 4,8 metros de longitud.

Las redes son semiplanas, con dos caras, y una longitud total de 25 – 35 metros. Existen tres secciones en la red: cuerpo, túnel y saco. La relinga de flotadores mide 27 metros mientras que la de plomos mide 29 metros. La malla es de poliamida ("nylon") de 52 milímetros estirada en el cuerpo, 50 milímetros en el túnel y 42 milímetros en el saco. El número de mallas circularmente en el cuerpo es de 350 a 420 mallas, los laterales 60 – 80 mallas, y los brazos 100 – 110. El saco está protegido adicionalmente por una malla adicional externa llamada "camisa", la cual previene roturas causadas por el desgaste de la malla en su contacto con el fondo marino. Esta malla es de hilo más grueso (76 – 89 milímetros). Durante su operación, las redes abren cerca de 1,5 metros sobre el fondo del mar (Alió, *et al.*, 1995).

La flota es casi totalmente uniforme en cuanto a los artes de pesca, ya que sólo se aprecian pequeñas diferencias en los artes entre las diferentes compañías de pesca.

**Uso del TED**

El uso obligatorio de esta rejilla, por las embarcaciones de arrastre que capturen camarones, fue establecido por resolución MAC-Dirección General Sectorial de Pesca y Acuicultura N°67 del 25/02/93 (publicada en Gaceta Oficial N° 35.159, 1993). Dicha rejilla fue originalmente concebida durante la década de los 80 para ser utilizada en el golfo de México (Watson & Seidel, 1980; Seidel & McVea, 1982), en momentos en que esa flota arrastrera orientaba sus operaciones fundamentalmente al camarón. La fauna acompañante, como peces, aguamalas, cangrejos, entre otros, era descartada al mar (Seidel & Oravetz, 1985). Este objetivo de pesca no es generalizable hoy en día entre las flotas. En Venezuela, por ejemplo, cerca de la mitad de las ganancias de la flota arrastrera derivan de la venta del pescado (Enríquez, 1997). Como consecuencia del uso de una rejilla con escasa separación entre los barrotes, se origina que el escape de peces de talla comercial sea muy elevado. De hecho, en el SE de los Estados Unidos, Watson & Taylor (1991) reportan que la reducción en la captura de peces con el uso del TED variaba entre 78% durante el día a 50% durante la noche. Por ello, las flotas que orientan su esfuerzo al camarón y a otros recursos demersales manifiestan continuamente la dificultad económica a que son sometidas, para poder mantener operativo el mercado estadounidense del camarón.

Motivado a la importancia de la captura de peces y moluscos en la pesca de arrastre en Venezuela, se realizaron ensayos con el dispositivo tipo TED para medir el impacto causado sobre las capturas comerciales durante los 4 años que siguieron a su introducción en la flota (1994 - 1998). Se observó que la captura promedio de peces se redujo en la red con el TED en un 35 y 50% para la zona oriental y occidental de Venezuela, respectivamente; la de camarones lo hizo en 29 y 8%, mientras que las capturas comerciales en general se redujeron en la red con TED en 33 y 41% para ambas zonas, respectivamente (Marcano *et al*,. 1998).

## 11. NORMATIVA LEGAL

La ley que rige y norma la actividad pesquera nacional data desde 1944. Para entonces, la pesca que se desarrollaba en el país era totalmente artesanal y la acuicultura no existía. Cuando surge la pesca de arrastre durante la década de los 50, fue necesario elaborar una resolución o reglamento que normara las actividades de esta pesquería. Así surgió la Resolución MAC-DG-OP No. 473 del 16/10/74, que regula las operaciones de las unidades de arrastre dentro de ciertos límites geográficos.

El 08/11/78 entra en vigencia la Resolución MAC No. 360, cuyo objetivo es unificar las dimensiones de las mallas de las redes utilizadas por la flota. Según esta Resolución las redes deberían estar conformadas de la siguiente manera:

a) Primer cuerpo o parte principal, entre el cañón y las cuendas: 6 centímetros medidos diagonalmente o 2.5 centímetros entre nudos.

b) Segundo cuerpo o cañón: 3,8 centímetros o 1,9 centímetros entre nudos.
c) Tercer cuerpo o copo: 3,2 centímetros o 1,6 centímetros entre nudos.

Esta medida permite el uso de camisas y cadenas de peso no mayor de 150 kilogramos.

Posteriormente se dictó la Resolución conjunta MAC-DGSPA No. 000183/MTC-DGSTM del 05/05/80, mediante la cual se obligaba a las embarcaciones a llevar una franja de 20 centímetros de ancho en la parte más visible del puente, de un color determinado de acuerdo a su tamaño (eslora). Asimismo, se obliga a llevar una figura geométrica para identificar su puerto base.

En 1980, se dictó la Resolución conjunta con el Ministerio del Ambiente y los Recursos Naturales Renovables (MARNR), MAC/DGSPA-46 y MARNR/DAA-103, la cual fue el resultado de modificaciones sustanciales a la Resolución anterior. El objetivo de ésta fue extender aun más las áreas de pesca reservadas a los pescadores artesanales, a fin de evitar las interferencias entre estas dos pesquerías.

A fin de detener el crecimiento incontrolado de la flota de arrastre, en julio de 1989, la Dirección General Sectorial de Pesca y Acuicultura del MAC, junto con la Dirección de Transporte Acuático del MTC acordaron congelar la construcción de nuevas unidades de arrastre, acuerdo que aun se mantiene vigente.

Mediante el Decreto Presidencial No. 2.667, dictado el 26 /11/92, se establecen períodos de vedas en el ámbito regional y nacional para la actividad de la pesca de arrastre. Los períodos fueron los siguientes: del 16/05 al 15/06 se prohíbe la pesca de arrastre en la zona oriental del país; del 16/07 al 15/08 se prohíbe la pesca de arrastre en la zona occidental y del 15/12 al 16/01 del siguiente año se prohíbe la pesca de arrastre a nivel nacional.

En 1993, Venezuela también se acogió a los programas para la conservación de las tortugas marinas. En este sentido, durante ese año se dictó la Resolución MAC-DGSPA No. 67, de fecha 25/02/93, que establece el uso obligatorio del TED en todas las unidades de arrastre que se dediquen a la captura del camarón. Asimismo, especifica el tipo de TED a usar y las características estructurales del mismo.

Por último, la Resolución MAC-039, de fecha 13/02/96, establece el ordenamiento de la pesquería de arrastre en Venezuela basado en el esfuerzo óptimo por zona de pesca como criterio de manejo, mediante la creación de los Comités Locales de Seguimiento para la Pesca Industrial de Arrastre (CLOSE).

## 12. PROBLEMAS AMBIENTALES

### Impacto del arte de arrastre sobre las comunidades de peces

Dado que la pesca de arrastre fue originalmente camaronera, es común oír relatos entre los empresarios de este sector acerca del efecto "positivo" del uso de la red de arrastre al permitir "arar" o "limpiar" el fondo marino, lo cual conlleva a la desaparición de especies de peces de poco interés (el bagre *Cathorops spixii*, por ejemplo) y el aumento de las poblaciones de camarones. Son escasas las evaluaciones históricas que permitan verificar esta aseveración cualitativa. Sin embargo, en el delta del río Orinoco se ha podido evidenciar cómo el reciente desarrollo de una pesquería de arrastre artesanal ha conducido a una rápida desaparición de ciertas especies de peces (en particular Elasmobranquios y Ariidae), los cuales son depredadores del camarón (Novoa y Marcano, 1999). Por otra parte, Novoa y col. (1993) describen como, luego de 30 años de actividad de la pesquería de arrastre en el golfo de Venezuela, la composición de los descartes cambió, desapareciendo casi completamente la de peces cartilaginosos (rayas y pequeños tiburones) y algunos teleósteos de la familia Sphiraenidae.

Es posible que el impacto creado por la pesca industrial de arrastre sobre diversas especies de peces con interés comercial, genere interferencias con otras pesquerías (artesanales) que también comparten dichos recursos. Giménez y col. (1993) describen que las interferencias son debido a que ambas pesquerías faenan en áreas comunes, ocasionando que los artes industriales interfieran físicamente con los artesanales y que la reducción de las especies de peces afecte más severamente a los pescadores artesanales. A este problema se suma el hecho de que, en la medida que la flota industrial de arrastre creció en número (duplicándose entre 1981 al 1990, al pasar de 200 a 450 embarcaciones), la operación de la flota en áreas cercanas a la costa (legalmente reservadas a la pesquería artesanal) ha venido en aumento, magnificando la destrucción de las áreas de desove y el crecimiento de muchas especies de peces que utilizan esas áreas para su reproducción.

**Necesidad del uso de sistemas que reduzcan la captura de fauna incidental**

Considerando los resultados obtenidos en los ensayos del uso de paneles de escape en las redes de arrastre camaronera, surgió la propuesta del sector oficial de incorporar como obligatorio su empleo en el país. Sin embargo, la imposición del uso de los dispositivos tipo TED en 1994 imposibilitó la implementación del empleo de paneles de escape, al no ser políticamente viable imponer, simultáneamente, los dos tipos de dispositivos de exclusión de fauna acompañante.

Existen conversaciones recientes entre el sector oficial y el empresariado de arrastre para ensayar nuevos paneles de escape, junto con modificaciones al TED (separación de los barrotes), para buscar una combinación apropiada que conduzca a una reducción en la captura incidental de tortugas marinas y a una disminución de la captura de fauna acompañante no comercial.

En general, puede apreciarse que el empresariado de arrastre y las tripulaciones no están ganados a la idea de modificar los artes de pesca para hacerlos más selectivos. Es muy probable que esta actitud se haya visto reforzada por la imposición del uso del TED en zonas donde la captura de tortugas era ya de muy pequeña magnitud, debido a las considerables pérdidas económicas asociadas a la reducción en la captura de peces (estimada en 45% por Marcano *et al.*, 1998) por escape a través del TED, así como por la constante rotura de los TED por piedras y palos, al operar en zonas cercanas a las desembocaduras de ríos. Por otra parte, el empleo de modificaciones a los artes que faciliten el escape de fauna acompañante no deseada, induce capturas más limpias de camarones, peces e invertebrados en mejor estado físico, que facilitan el trabajo de las tripulaciones. En particular, la reducción en la captura de agua malas (importante componente de la fauna de descarte, Tablas 14 a la 16) ha sido en Venezuela y otros países un elemento que induce a las tripulaciones al empleo de modificaciones a los artes de pesca que induzcan su salida. El empleo de rejillas en las redes, como el TED, ha resultado útil para este propósito.

**BIBLIOGRAFIA**

Aduana Principal de Maracaibo 1999. Estadísticas de exportación de productos pesqueros desde la aduana principal de Maracaibo durante 1998. Venezuela. Ministerio de Hacienda, Servicio Nacional Integrado de Administración Tributaria, Maracaibo.

Alió J.J. 2000. Los recursos vivos del sistema de Maracaibo. Cap 11 en: G. Rodríguez (Ed.) "El sistema de Maracaibo" 2ª. Edición. Edit. IVIC, Caracas. 264 pp.

Alió J.J., L. A. Marcano & E. Trujillo, 1995. Use of escape panels for fish in shrimp trawl nets. Third Workshop on the biological and economical modeling of the shrimp resources on the Guyana-Brazil shelf. Paramaribo, Suriname, June, 1992. FAO Fish. Rep. No. 526 (Supplement):189-196.

Alió J.J., L. Ferreira, K. Goriesingh, S. Kuruvilla, L. Maharaj, L. Marcano, I. Ramnarine & D. Die, 1999. Evaluation of the *Penaeus subtiisl* stock within the Orinoco river delta and Gulf of Paria region. Working Group Report. Assessment Workshop on the shrimp and groundfish fishery on the Guyana-Brazil shelf. Port of Spain, Trinidad, April, 1997. FAO Fish. Rep. 600 (Supplement):153-167.

Altuve D., E. Trujillo, J.J. Alió, A. Ginéz, L. Marcano & A. Urbaneja 1998. Ensayos preliminares sobre paneles de escape en redes de arrastre artesanal camaronero. Memorias I Jornadas Técnicas de la región oriental (Anzoátegui, Monagas, Sucre y Nueva Esparta). Maracay, Venezuela. FONAIAP, Centro de Investigaciones Agropecuarias de los estados Sucre y N. Esparta. 192 p. (Publicación Especial No. 35).

----------; R. Alvarez, L. Majaraj, J. Páez C., N. Ehrhardt, L. Marcano & J.J. Alió 1999. Analysis of industrial and artisanal trawl fisheries of white shrimp, *Penaeus schmitti*, of the Gulf of Paria and Atlantic margin of Venezuela. Preliminary results. Second CFRAMP/FAO/DANIDA Stock Assessment Workshop on the Shrimp and Groundfish Fisheries of the Brazil-Guianas Shelf. Georgetown, Guyana 18-29/5/1998. FAO Report on Activities 46 (Suplement 1):71-90.

Andrade de Pasquier G. 1996. Análisis de la pesquería del camarón blanco, *Penaeus schmitti* Burkenroad 1936, en el Lago de Maracaibo, Venezuela. Tesis de MSc. Univ. de Coquimbo, Chile. 105 pp.

Anónimo 1990. Surveys of the fish resources in the shelf areas between Suriname and Colombia 1988. Inst. Mar. Res. Bergen, Norway.

Bashirullah A.K.M. & L.B. Lárez, 1974. Arrastres exploratorios en la plataforma continental de la Guayana. I. Especies de camarones capturados y su abundancia relativa. Bol. Inst. Oceanogr. UDO, Cumaná, 12 (2): 15-22.

Cadima E., J.J. Ewald, H. Montesinos, W. Díaz & D. Novoa. 1972. La pesquería de camarones en el occidente de Venezuela. Inf. Tec. No. 52. MAC-FAO-PNUD.

Cervigón F. 1982. La Ictiofauna Estuarina del caño Mánamo y áreas adyacentes. Los Recursos Pesqueros del Río Orinoco y su Explotación. D. Novoa, ed. , Caracas, 386 p.

---------- *et al.* 1992. Ficha FAO de identificación de especies para los fines de la pesca. Guía de campo de las especies comerciales marinas y de aguas salobres de la costa septentrional de Sur América. Preparado con el financiamiento de la Comisión de Comunidades Europeas de NORAD. Roma, FAO. 1992. 513 p.

Díaz W., J.J. Ewald, T. Nemoto, R. Chacón, T. Hernández y J. Jiménez 1972. El uso del "Cuaderno de Pesca" en la flota camaronera del Golfo de Venezuela. Inf. Tec. MAC-FAO-PNUD. No. 10: 18 p.

Ewald J.J. 1965. Investigaciones sobre la biología del camarón comercial en el occidente de Venezuela. Informe al Fondo Nacional de Investigaciones Agropecuarias (FONAIAP), 147 pp.

----------, W. Díaz & E. Cadima,1971. La pesca de arrastre en el Golfo de Paria. Proyecto de Investigación y Desarrollo Pesquero. MAC-PNUD/FAO. Inf. Técnico N° 29.

----------, W. Brandhorst, F. H. Durant, V. de Espinoza, & W. Díaz 1971. Cruceros de pesca exploratoria del arrastrero "Carmelina", en la zona occidental de Venezuela. Inf. Tec. No. 25. MAC-FAO-PNUD.

García S. & L. Le Reste 1986. Ciclos vitales, dinámica, explotación y ordenación de las poblaciones de camarones peneidos costeros. FAO Doc. Tec. Pesca 203:180 pp.

Giménez C., J.J. Salaya & R. Molinet. 1993. La pesca industrial de arrastre. Edit. Grupo Carirubana. Punto Fijo, Estado Falcón, 321 p.

Ginés H., 1972. Carta pesquera de Venezuela. 1.- Areas del Nororiente y Guayana. Monografía N° 16. Fundación La Salle de Ciencias Naturales, Caracas.

----------, 1982. Carta pesquera de Venezuela (2): área central y occidental. Fundación La Salle de Ciencias Naturales. Mon. 16, 328 p + Cartas.

Griffiths R. G. & J. G. Simpson 1974. Evaluación de los niveles actuales de explotación de los recursos pesqueros de Venezuela. Col. Cuadernos azules. III Conf. N. Derecho del Mar. Caracas, 91 p.

Henríquez N. O. 1997. Evaluación del sector industrial de arrastre y su impacto en el desarrollo económico del Estado Sucre durante 1996. Trabajo Especial de MSc. en Administración, Universidad Bicentenaria de Aragua, Maracay, Venezuela.

Lundberg H., W. Bradhorst & E. Racca 1970. La flota de arrastreros en Venezuela. Período: 1968-1969. Inf. Tec. No. 10. MAC-FAO-PNUD.

MAC-SARPA 1996. La Actividad Pesquera - Acuícola en Venezuela. MAC/SARPA, Caracas. 105 p.

Marcano, L.A. 1990. Análisis de la situación de la industria de la pesca de arrastre durante el período 1985-1989. En: "Resultados de talleres sobre la pesca en Venezuela", p: 25-52, MAC-DGSPA, Caracas, 126 p.

---------- 1998. Fauna de acompañante del camarón en la pesca industrial de arrastre de la región nororiental de Venezuela. Informe del Taller Regional sobre la utilización de la fauna de acompañamiento del camarón (FAC). Camagüey, Cuba 23-27 Junio 1997. CIP-FAO 48 p.

----------, J.J. Alió, D.E. Altuve & J. Celaya 1995. Venezuelan shrimp fisheries in the Atlantic margin of Guayana. Third Workshop on the biological and economical modeling of the shrimp resources on the Guyana - Brazil shelf.Suriname, 22-25 june 1992. FAO Fish. Report N 526 Supplement, Rome, FAO 1995: 200 p.

----------, J.J. Alió & D. Altuve. 1997. Technical Report of Venezuela: Venezuelan shrimp Fisheries on the Atlantic Margin of Guyana (Revised version 1994). In : National Report and selected papers presented at the Fourth meeting of the WECAFC Ad Hoc Shrimp and Groundfish Working Group of the Guianas-Brazil Continental Shelf and CFRAMP Shimp and Groundfish Subproyect Specification Workshop. Port Spain, Trinidad and Tobago, 8-12 January 1996. FAO Fisheries Report. No. 544, Suppl. 248 p.

---------- & J.J. Alió 1998. Captura incidental de Tortugas en la pesca industrial de arrastre camaronera, de la región nororiental de Venezuela. 18vo. Simposio Internacional sobre biología y Conservación de Tortugas Marinas. Mazatlán, México, 27/02 al 07/03 de 1998.

----------, J.J. Alió & R. Lozada. 1998. Estimación del impacto causado sobre las capturas por el uso de Rejillas para Excluir Tortugas de las redes de arrastre en Venezuela. 18° Simposio Internacional sobre Biología y Conservación de Tortugas Marinas. Mazatlán, México, 27/02 al 07/03 de 1998.

Mendoza, J., L. A. Sánchez & L.A. Marcano 1994a. Variaciones en la distribución y abundancia de los principales recursos explotados por la pesquería de arrastre del nororiente de Venezuela. I. PECES. Memorias de la Sociedad de Ciencias Naturales La Salle. Tomo 54(142): 47-64. Julio/diciembre 1994.

---------- 1994b. Variaciones en la distribución y abundancia de los principales recursos explotados por la pesquería de arrastre del nororiente de Venezuela.. II. INVERTEBRADOS. Memorias de la Sociedad de Ciencias Naturales La Salle. Tomo 54(142): 65-81. Julio/diciembre 1994.

Montesinos H. & L.A. Marcano 1980. Esquema de la pesquería venezolana de camarón (Reporte Nacional). En: Proceedings of the working group on shrimp fishery. NE South America, FAO WECAFC Rep. 27:76-89, February.

Novoa D. 1982. El recurso camaronero del delta del Orinoco. En: Los Recursos Pesqueros del Río Orinoco y su Explotación. D. Novoa (editor), Editorial Arte, Caracas, 386 p.

---------- 1995. Evaluación del potencial pesquero camaronero en el "Area Especial de Pesca" del delta del Orinoco. Informe presentado al CONICIT, subvención Proyecto Pc- 080., 77 p.

---------- 2000. La pesca en el Golfo de Paria y delta del Orinoco costero. Edit. Arte, C.A. Caracas, 139 pp.

---------- & E. Cadima, 1972. Evaluación preliminar del estado de la pesquería de arrastre del camarón en la zona Nor-oriental de Venezuela. Proy. MAC-PNUD-FAO, Inf. Tec. N° 42.

----------, E. Cadima & E, Racca, 1972. La pesca de arrastre en la zona Nor-oriental de Venezuela. Proyecto MAC-PNUD-FAO, Inf. Tec. N° 55.

----------, J.E. Rabinovich & A. Urbaneja, 1980. Las pesquerías de arrastre en la zona nor-oriental de Venezuela. Bol. Soc. Ven. Cien. Nat., 35(138): 9-138.

----------, F. Cervigón & F. Ramos 1982. Catalogo de los Recursos Pesqueros del Delta del Orinoco. En: Los Recursos Pesqueros del Río Orinoco y su Explotación. D. Novoa, ed. Editorial Arte, Caracas, 386 pp.

---------- & F. Cervigón 1986. Resultados de los muestreos de fondo en el área estuarina del Delta del Orinoco. IOC/FAO Workshop on recruitment in tropical coastal demersal communities. IOC, Workshop Report No. 44, Ciudad del Carmen, Mexico, April 1986, pp.181-202.

----------, L.A. Marcano & L. Franco, 1993. Análisis histórico de la pesquería de arrastre del Golfo de Venezuela. Evaluación del estado actual de los recursos pesqueros y de la política de manejo de los años 1989-1990. Memoria, Sociedad de Ciencias Naturales La Salle 53(139):81-119.

----------, L. Marcano, J. Mendoza, R. Molinet & J. Cárdenas. 1996. La nueva política de ordenamiento de las pesquerías de arrastre en Venezuela.: Una propuesta. Mimeogr. 15 p.

----------, J. Mendoza, L. A. Marcano & J. Cárdenas, 1998. Atlas Pesquero Marítimo de Venezuela. MAC-SARPA y VECEP, Caracas, 197 p.

---------- & L. A. Marcano. 1999. Los Recursos Pesqueros en la desembocadura del Caño Mariusa y su explotación comercial. Resultado del Plan de Supervisión de la Pesca Artesanal. Mimeog. En prensa.

Pérez-Farfante I. 1970. Sinopsis de datos biológicos sobre el camarón blanco Penaeus schmitti Burkenroad, 1936. FAO Fish. Rep. 57: 1417-1438.

Pauly D. 1983. Algunos métodos simples para la evaluación de recursos pesqueros tropicales. FAO. Doc. Tec. Pesca, (234): 49 p.

Pomares F., O.; J. Alió; R. Alvarez & L. Marcano 1998. Evaluación del uso simultáneo del TED y paneles de escape para peces en redes de arrastre camaronero. Zoot. Trop. 16(1):19-39.

Racca E. & R. Griffiths 1972. Primera evaluación de los recursos demersales del Golfo de Venezuela. Inf. Tec. No. 53. MAC-FAO-PNUD.

Ramos F., D. Novoa & I. Itriago 1982. Resultados de los Programas de Pesca Exploratoria Efectuados en el delta del Orinoco. En : Los Recursos Pesqueros del Río Orinoco y Su Explotación. D. Novoa ed. Editorial Arte, Caracas, pp 169-191.

Rodríguez G. 1973. El sistema de Maracaibo. Primera edición. Edit. IVIC, Caracas. 395 pp.

---------- 1980. Crustáceos decápodos de Venezuela. IVIC, Caracas, 194 pp.

SARPA 1998. Estadísticas del sector pesquero marítimo de Venezuela para el período 1964-1997. Venezuela. Ministerio de Agricultura y Cría, Servicio Autónomo de los Recursos Pesqueros y Acuícolas, Caracas.

Salaya J. J., R. Guzmán & P. Penchaszadeh. 1980. Evaluación de la pesquería de arrastre de Golfo Triste y áreas adyacentes (Venezuela). En: Penchaszadeh, P. E. (De) Simp. Biología y Ecología de Organismos Acuáticos. Univ. Simón Bolívar.

Seidel W.R. & C. McVea, Jr. 1982. Development of a sea turtle excluder shrimp trawl for the southeast U.S. penaeid shrimp fishery. Pp. 497-502 *in* K.A. Bjorndal, Ed. Biology and Conservation of Sea Turtles. Smithsonian Institution Press. Washington DC. USA.

Seidel W.R. & C. Oravetz 1985. TED Trawling efficiency device (Turtle excluder device): Promoting its use. Proceed. First Internat. Symp. Kemp's Ridley Sea Turtle Biol, Conserv. Manag. Oct. 1-4 1985, Galveston, Texas. Rep. Texas A&M Univ. Sea Grant Program.

Watson, J. W. & W.R. Seidel 1980. Evaluation of techniques to decrease sea turtle mortalities in the southeastern United States shrimp fishery. ICES CM, B31, 1-8.

Watson, J.W. & C.W. Taylor 1991. Research on selective shrimp trawl designs for penaeid shrimp in the United States: A review of selective shrimp trawl research in the United States since 1973. Proceed. Fish. Conserv. Engineer. Workshop, pp. 50-59, Publ. Rhode Island Sea Grant College Prog.

TR/D/Y2859E/1/12.01/600